

An AeroCom intercomparison exercise on state-of-the-art organic aerosol global modeling

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+68 more authors from 44 institutions
with 31 models and >1000 measurement locations

AeroCom aim

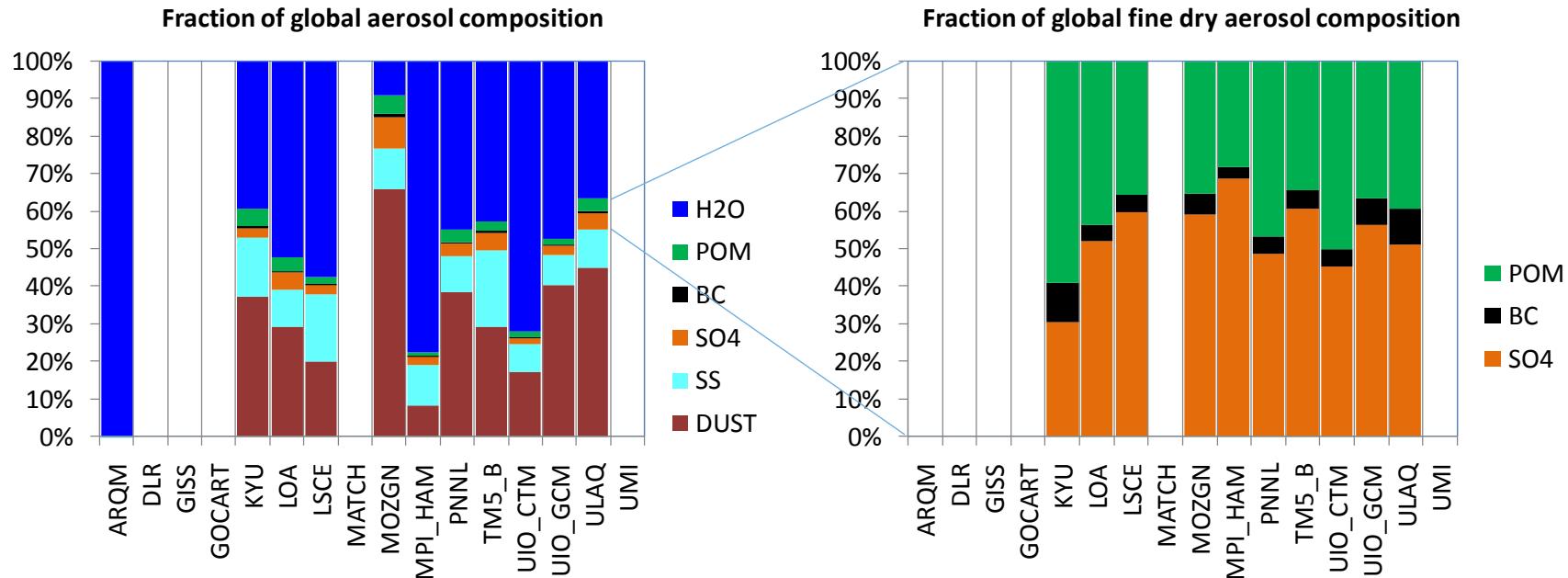
- Document global organic aerosol modeling
- Quantify robustness of model parameterizations
- Why models differ
- Why models are the same
- How do models compare with measurements
- How we can use measurements to improve models

Modeling aim

We need a finite number of tracers to model:

- Chemical/physical properties
- Size distribution
- Optical properties (direct effect)
- CCN (indirect effect)
- Time evolution

OA within AEROCOM

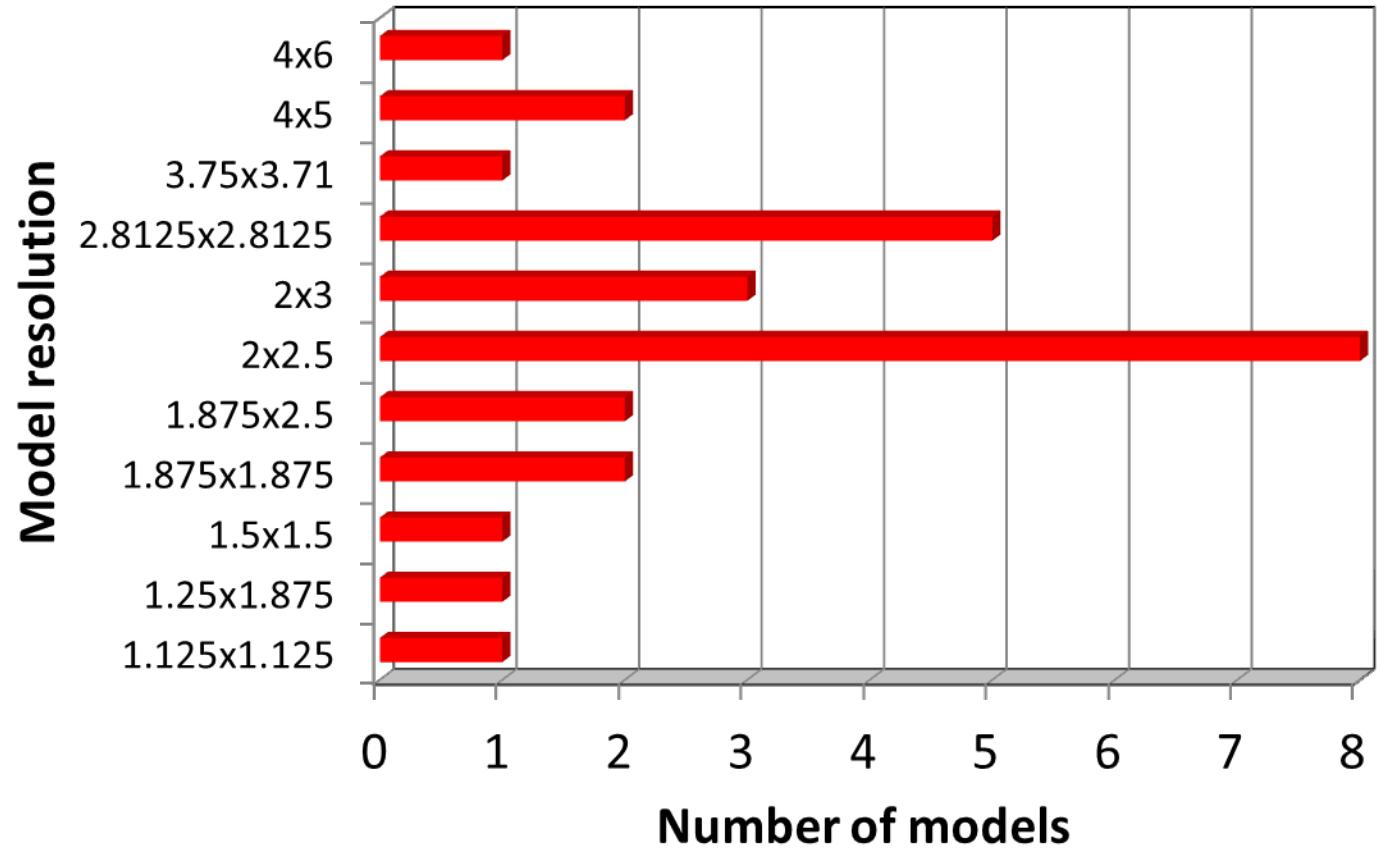
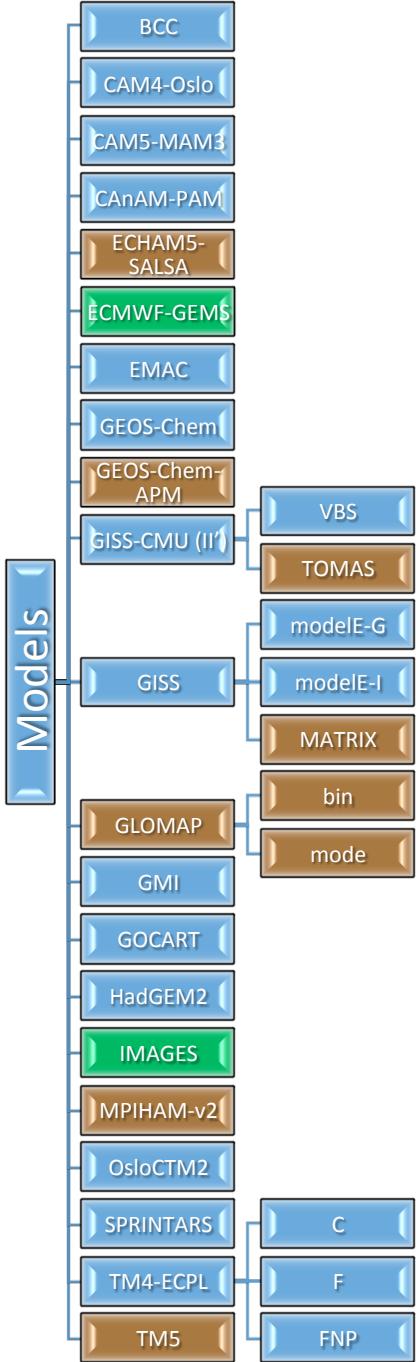


Modified from Textor et al., 2006

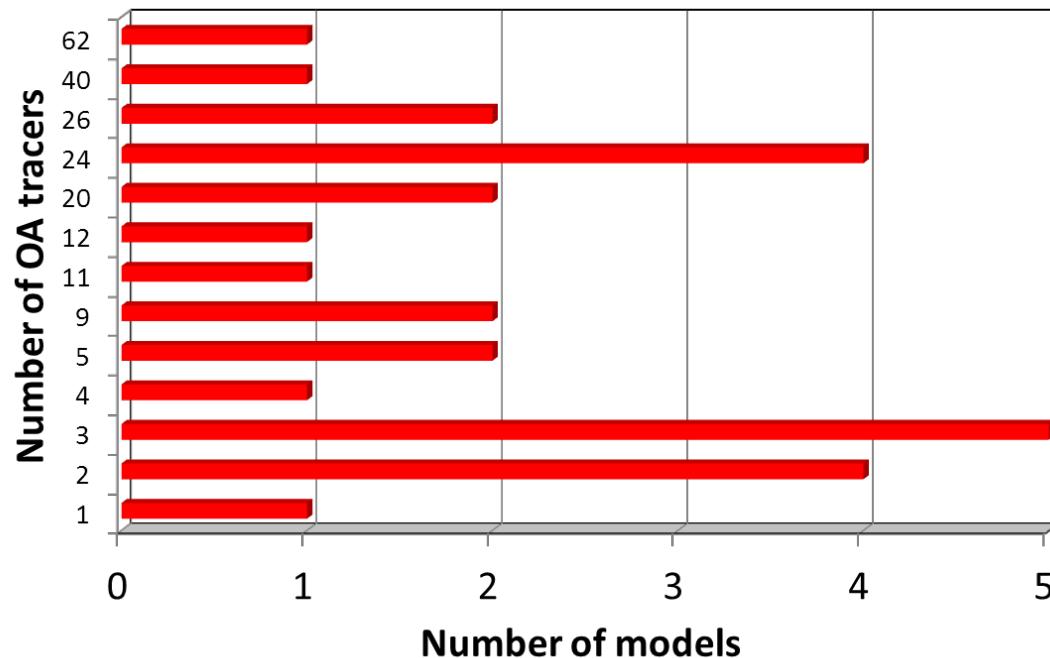
31 models

BCC
CAM4–Oslo
CAM5–MAM3
CanAM–PAM
CCSM4–Chem
ECHAM5–HAMMOZ
ECHAM5–SALSA
ECMWF–GEMS
EMAC
GEOS–Chem
GEOS–Chem–APM
GISS–CMU–TOMAS
GISS–CMU–VBS
GISS–MATRIX
GISS–modelE–G
GISS–modelE–I
GISS–TOMAS
GLOMAPbin
GLOMAPmode
GMI
GOCART
HadGEM2–ES
IMAGES
IMPACT
LMDz–INCA
MPIHAM–v2
OsloCTM2
SPRINTARS
TM4–ECPL–F
TM4–ECPL–FNP
TM5

of OA tracers : 1 - 62
of SOA tracers: 1 - 22

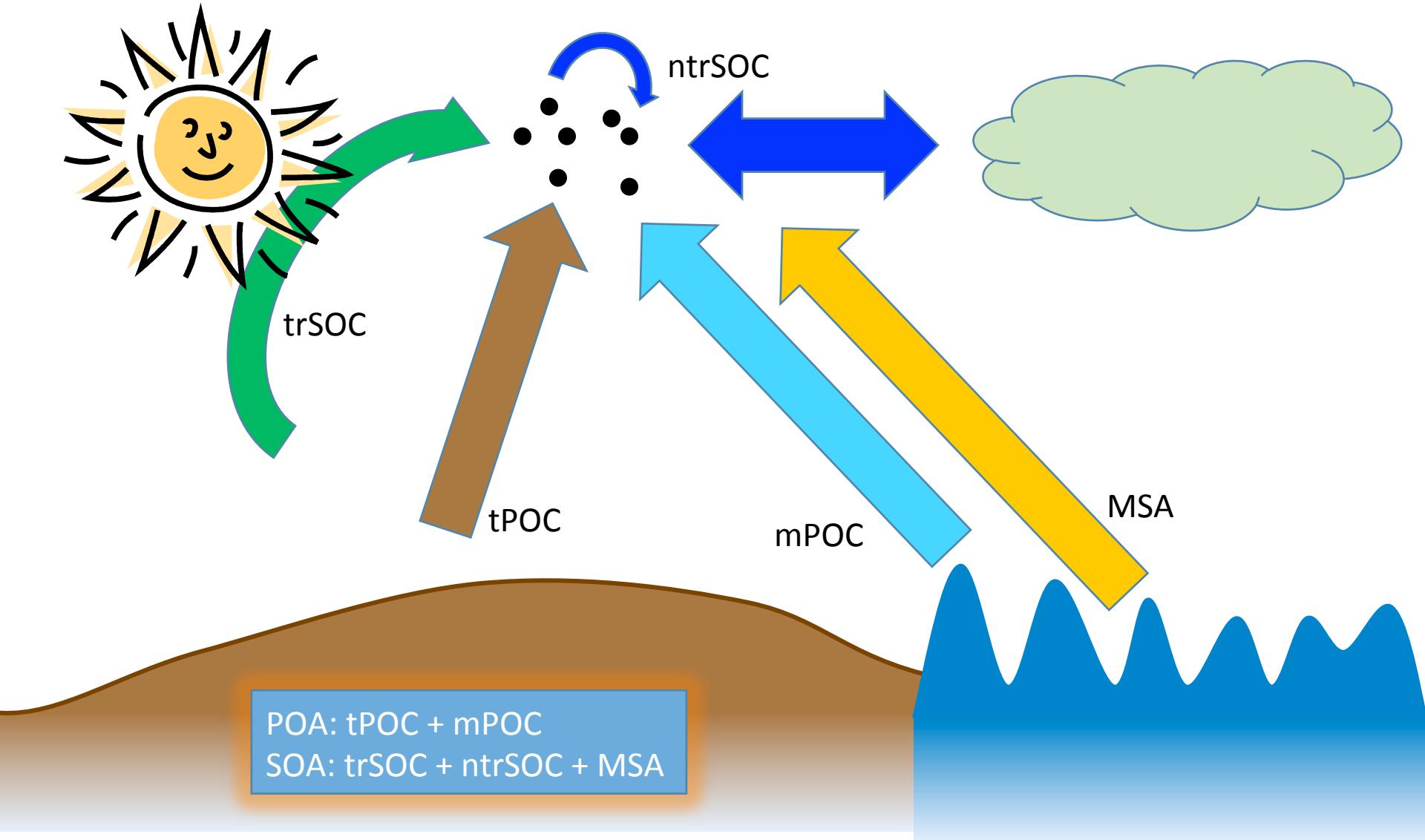


- Year(s) simulated: Mostly 2006, but not always with 2006 emissions and/or meteorology.
- Focus on surface concentrations, at least for now.
- Emissions vary greatly. This is not necessarily bad.
- OM/OC is 1.4 for most models, but not all.



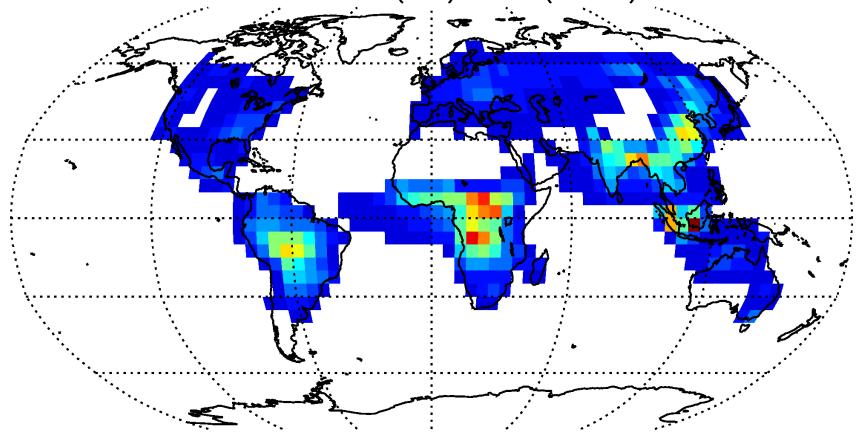
Models

Source apportionment

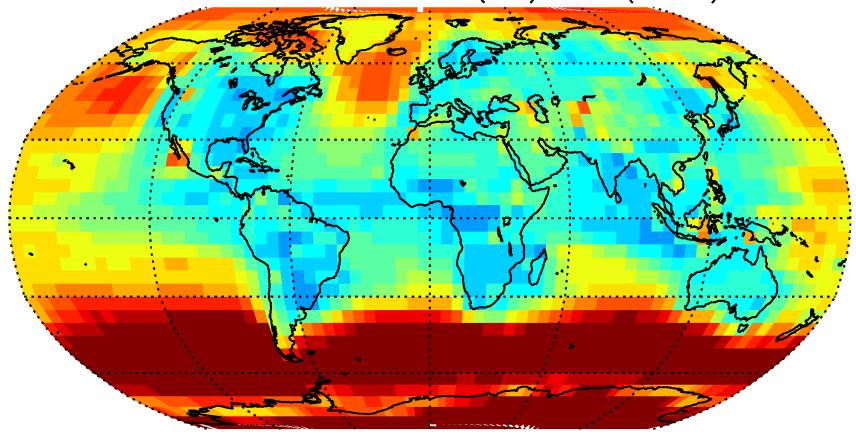


Median model

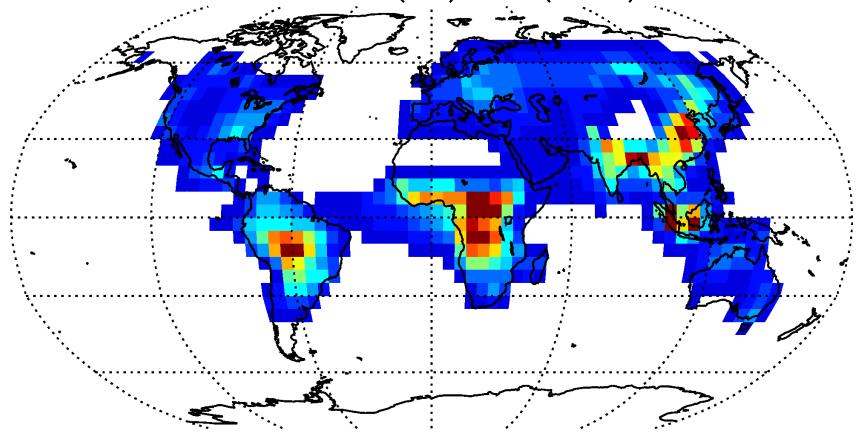
Median model (5x5) – OC (Annual)



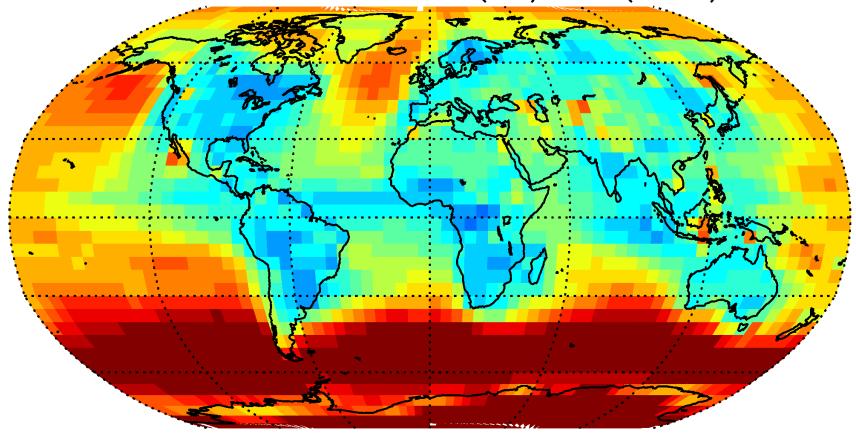
stddev-to-mean of models (5x5) – OC (Annual)

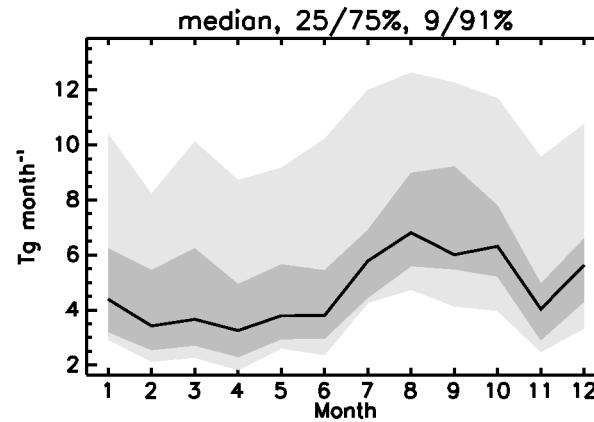
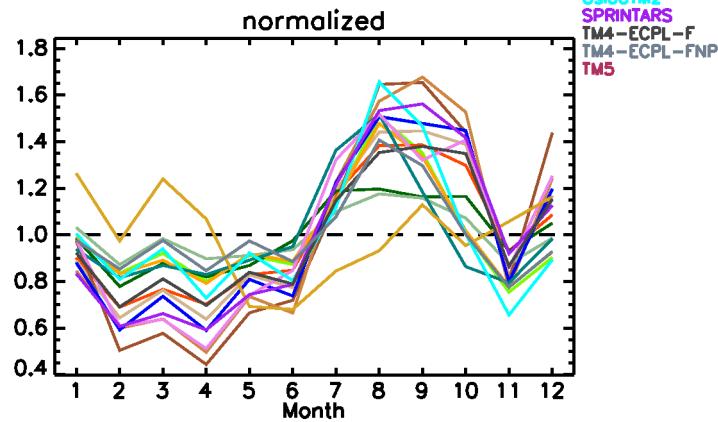
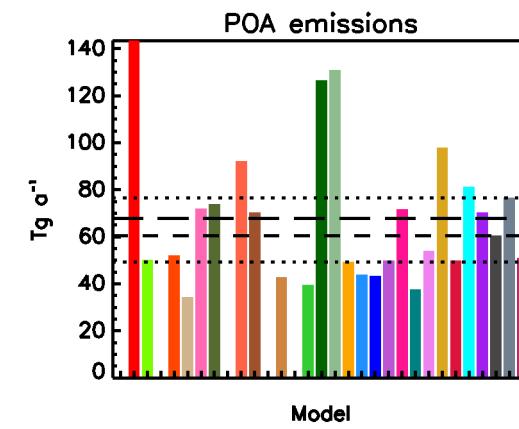
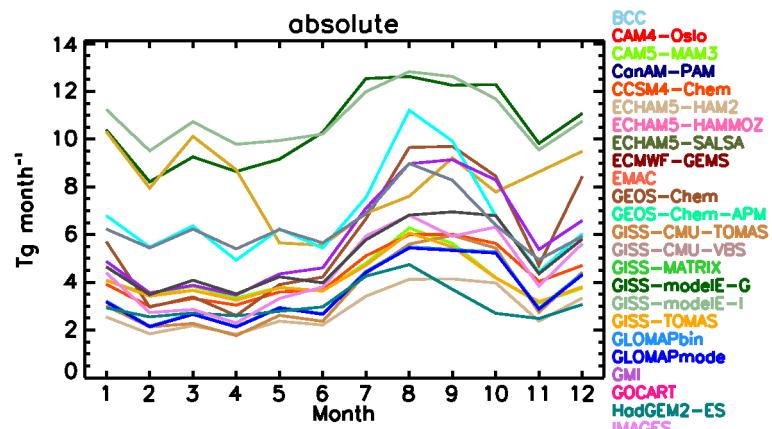


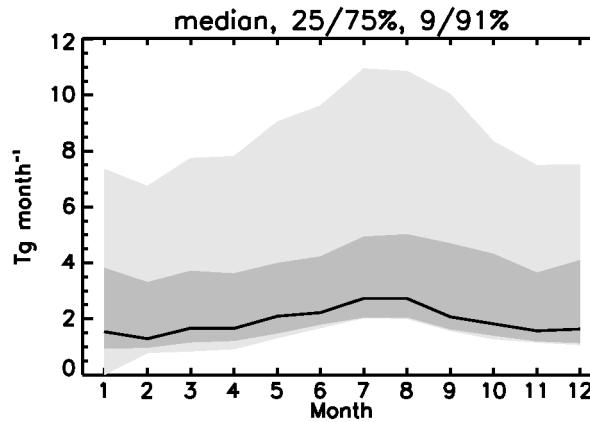
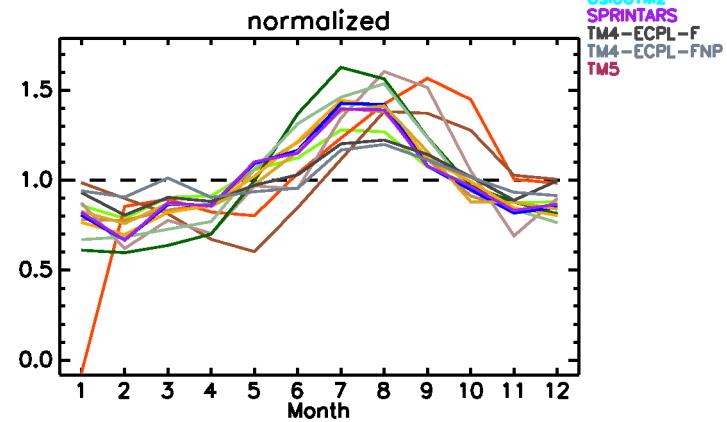
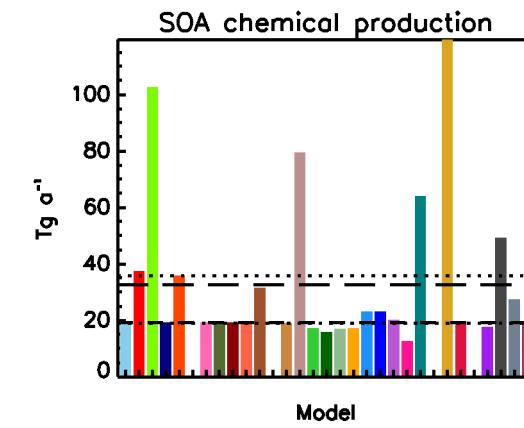
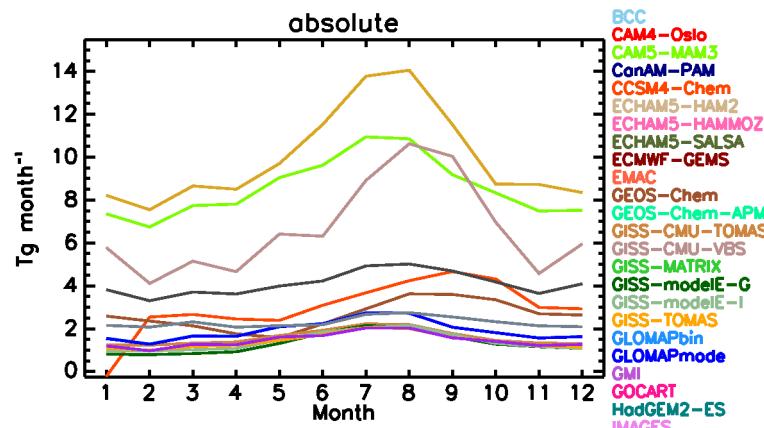
Median model (5x5) – OA (Annual)

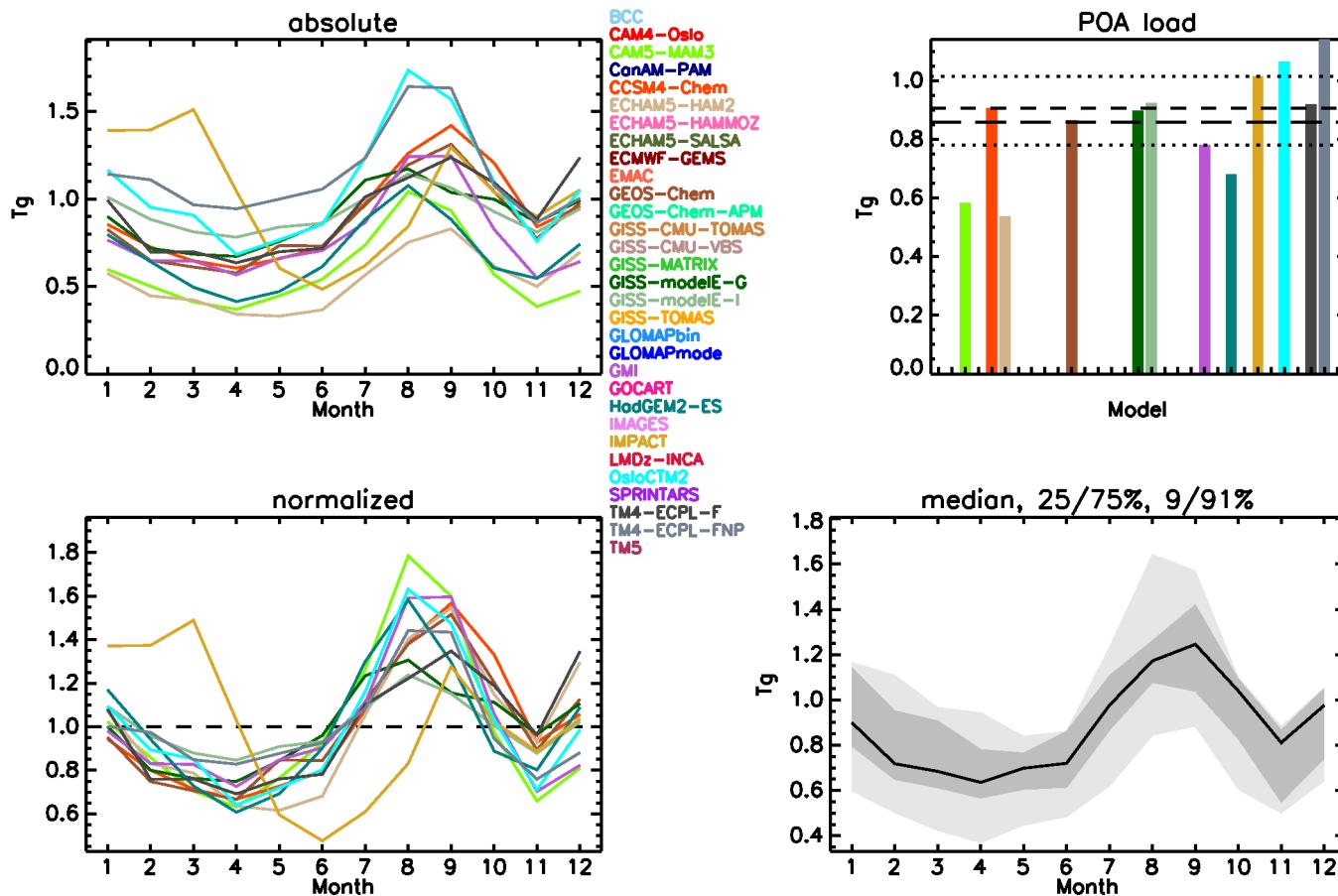


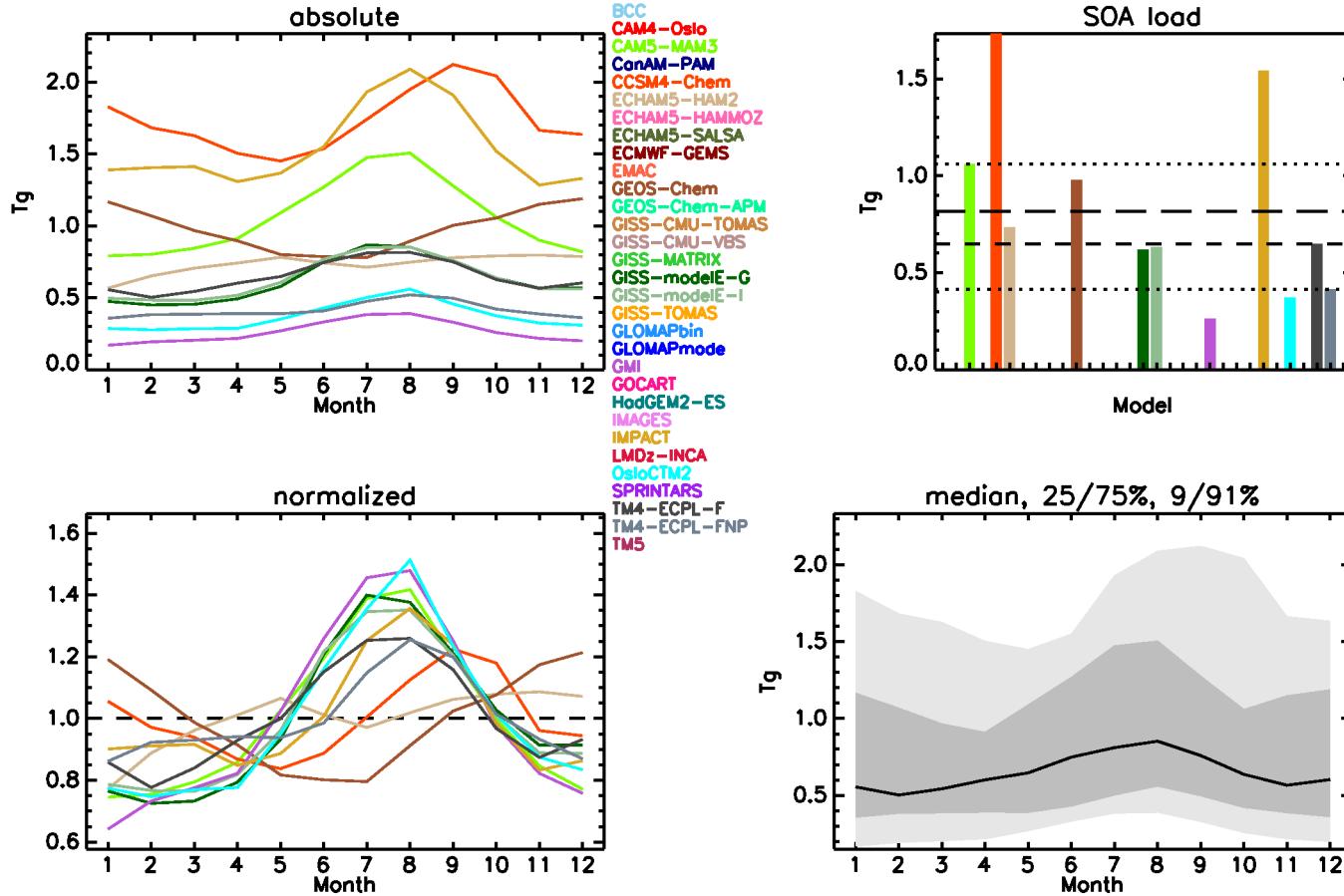
stddev-to-mean of models (5x5) – OA (Annual)

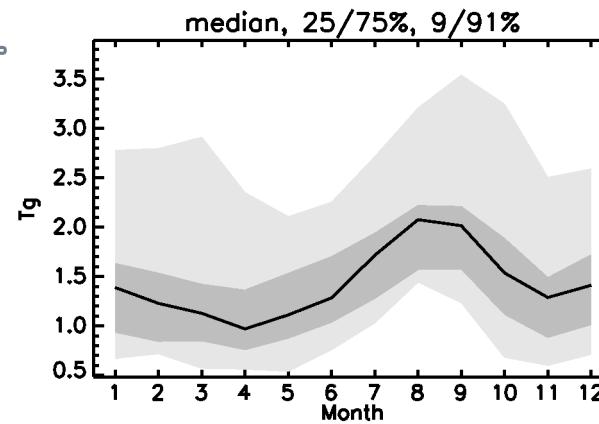
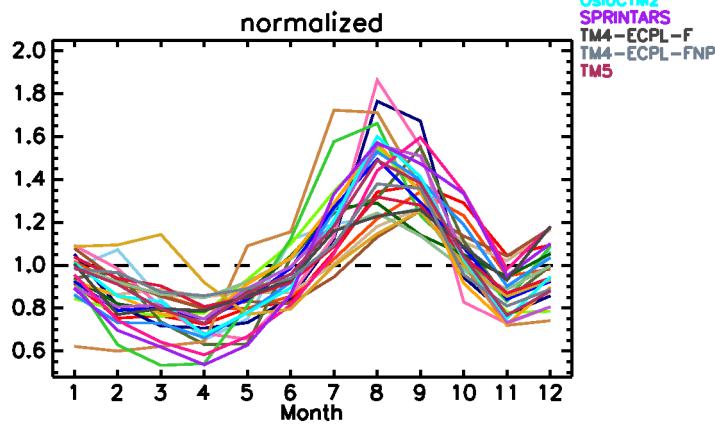
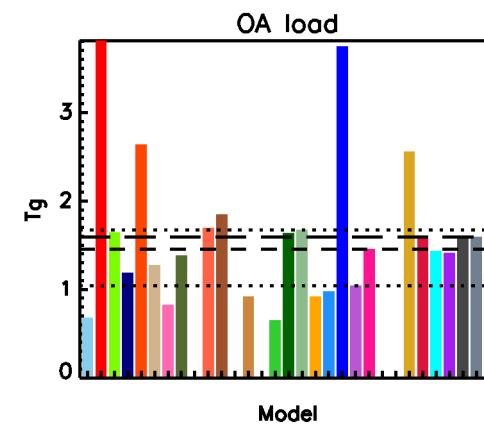
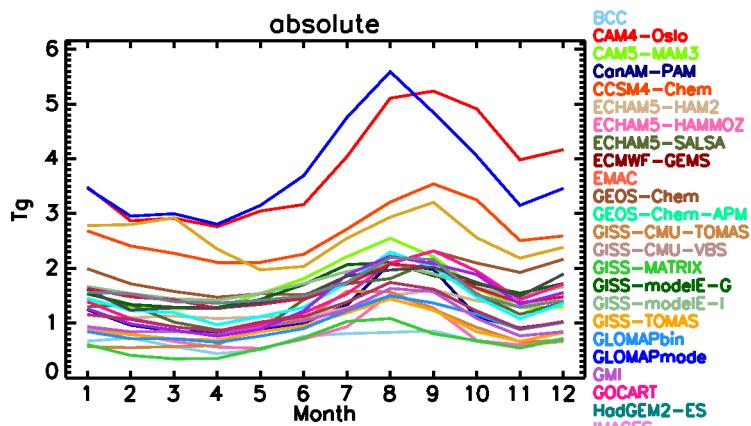


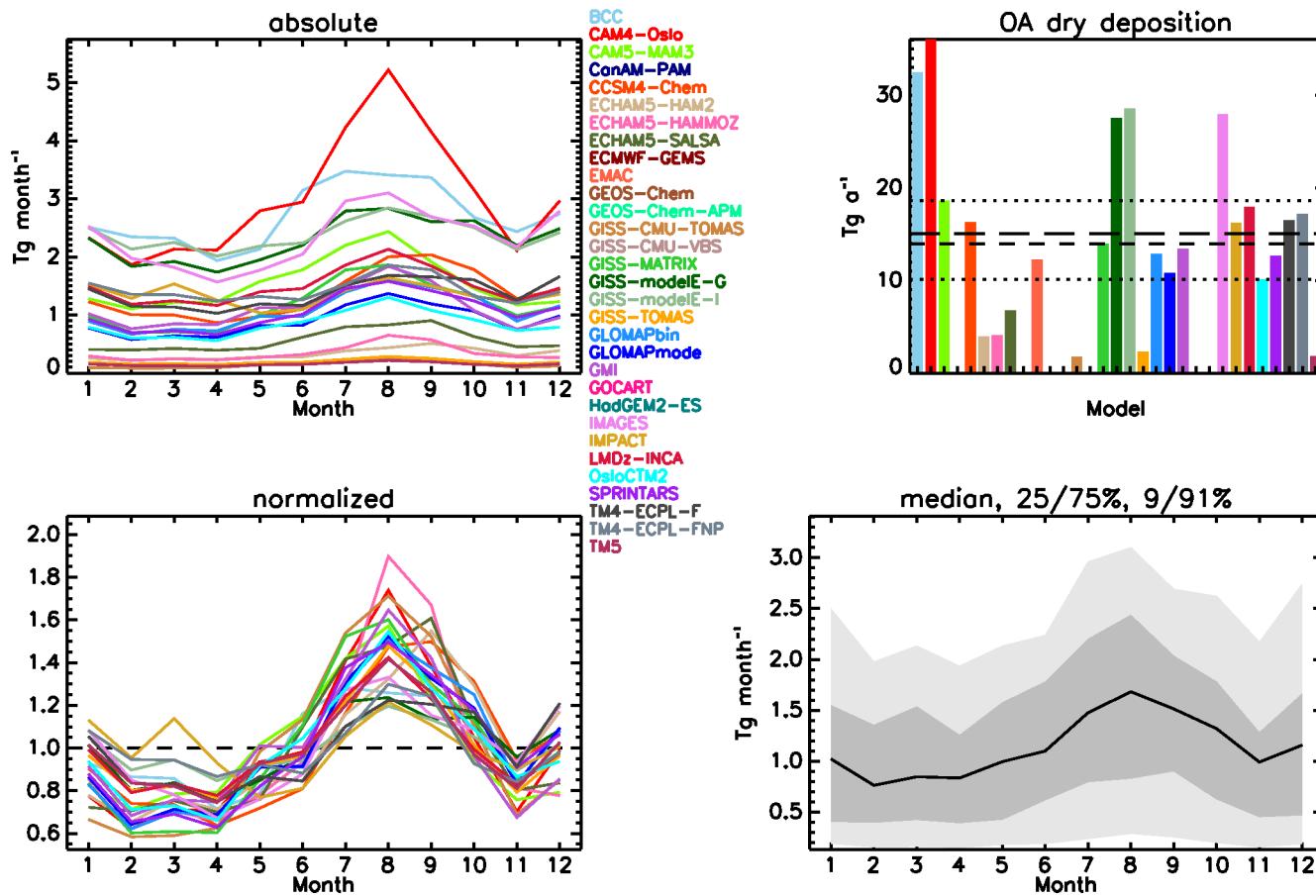


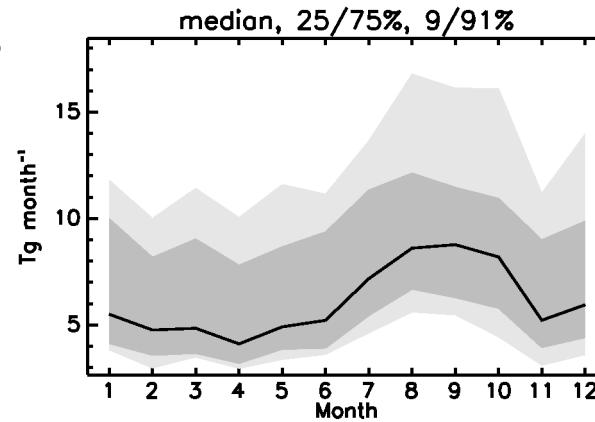
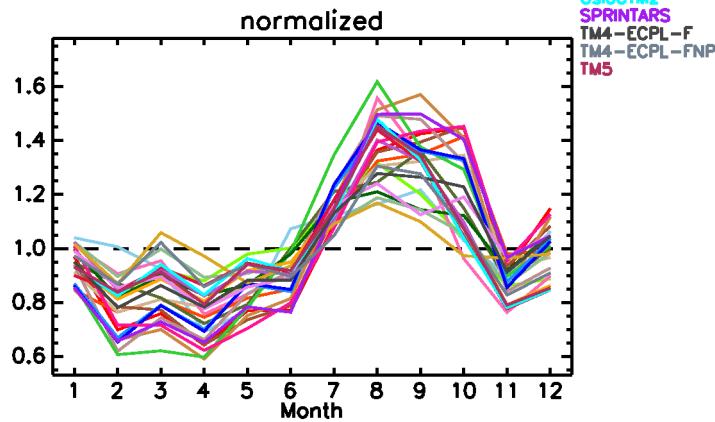
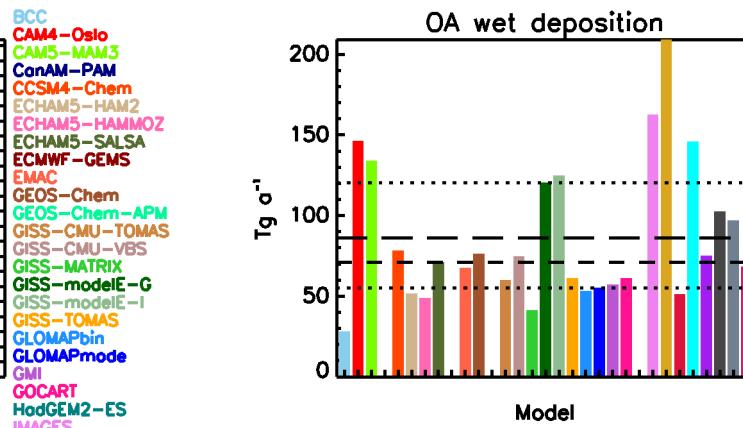
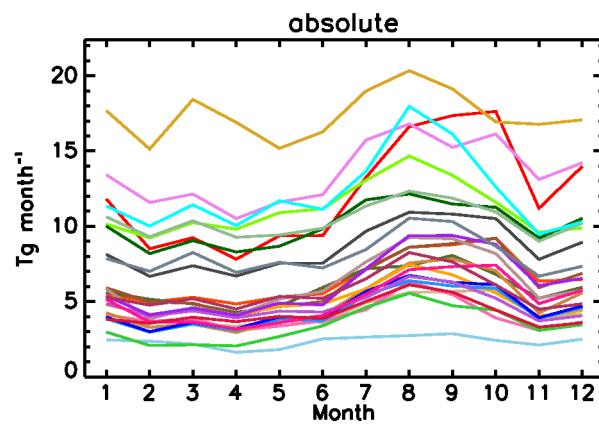


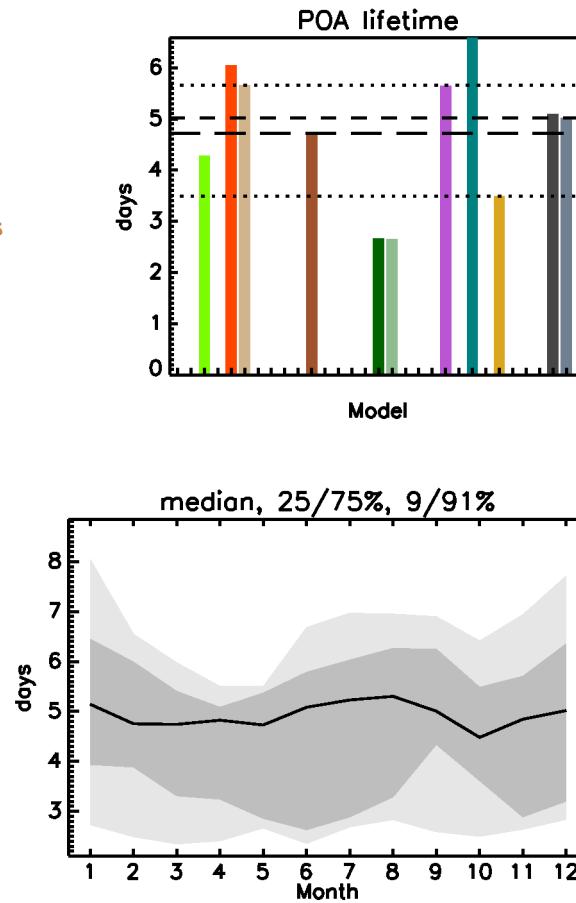
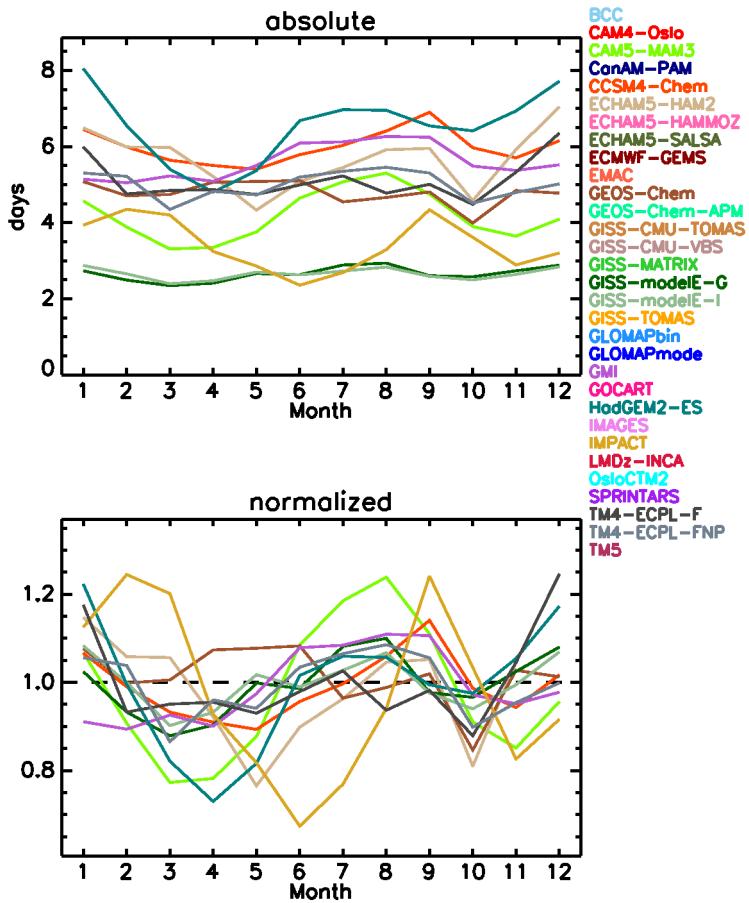


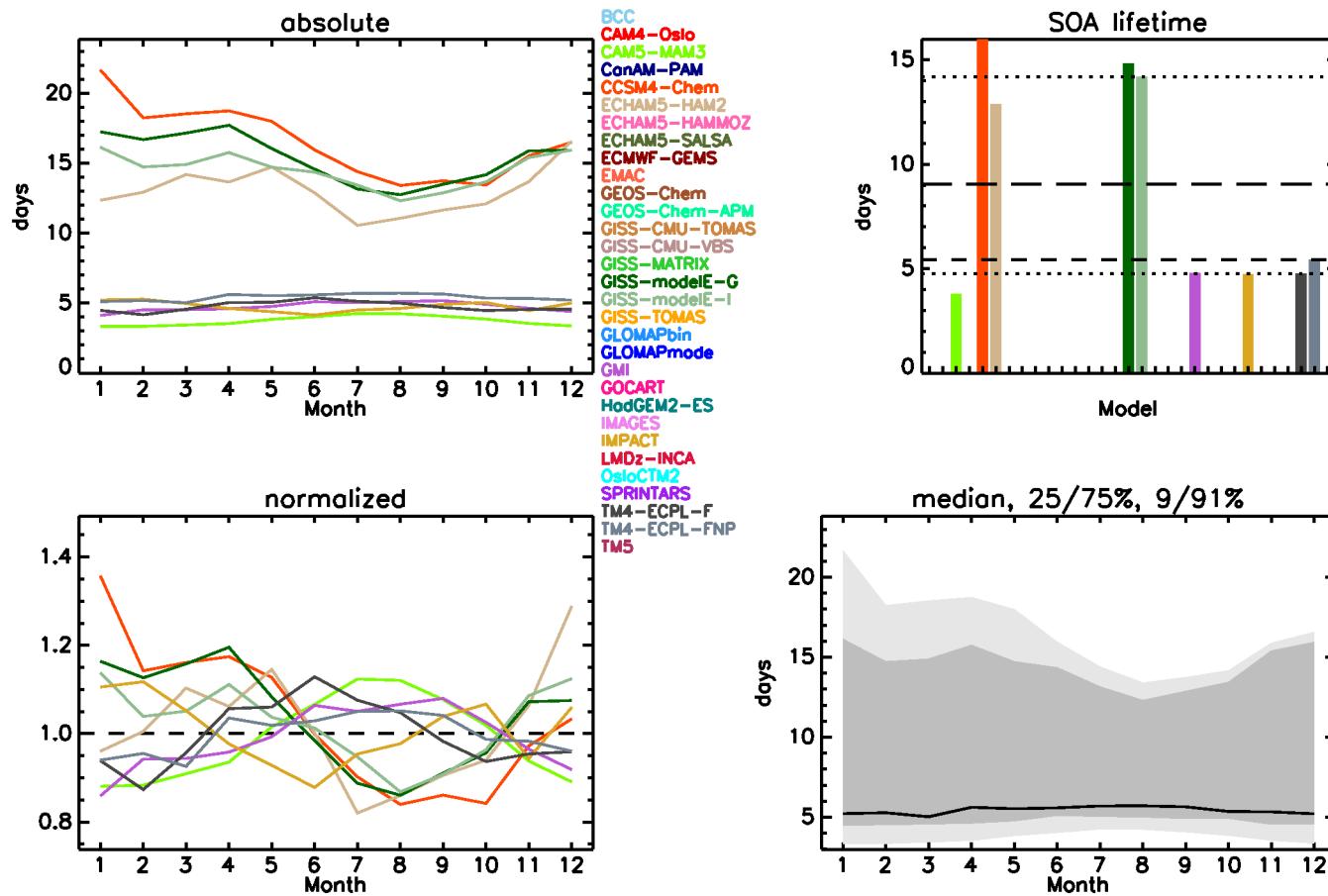


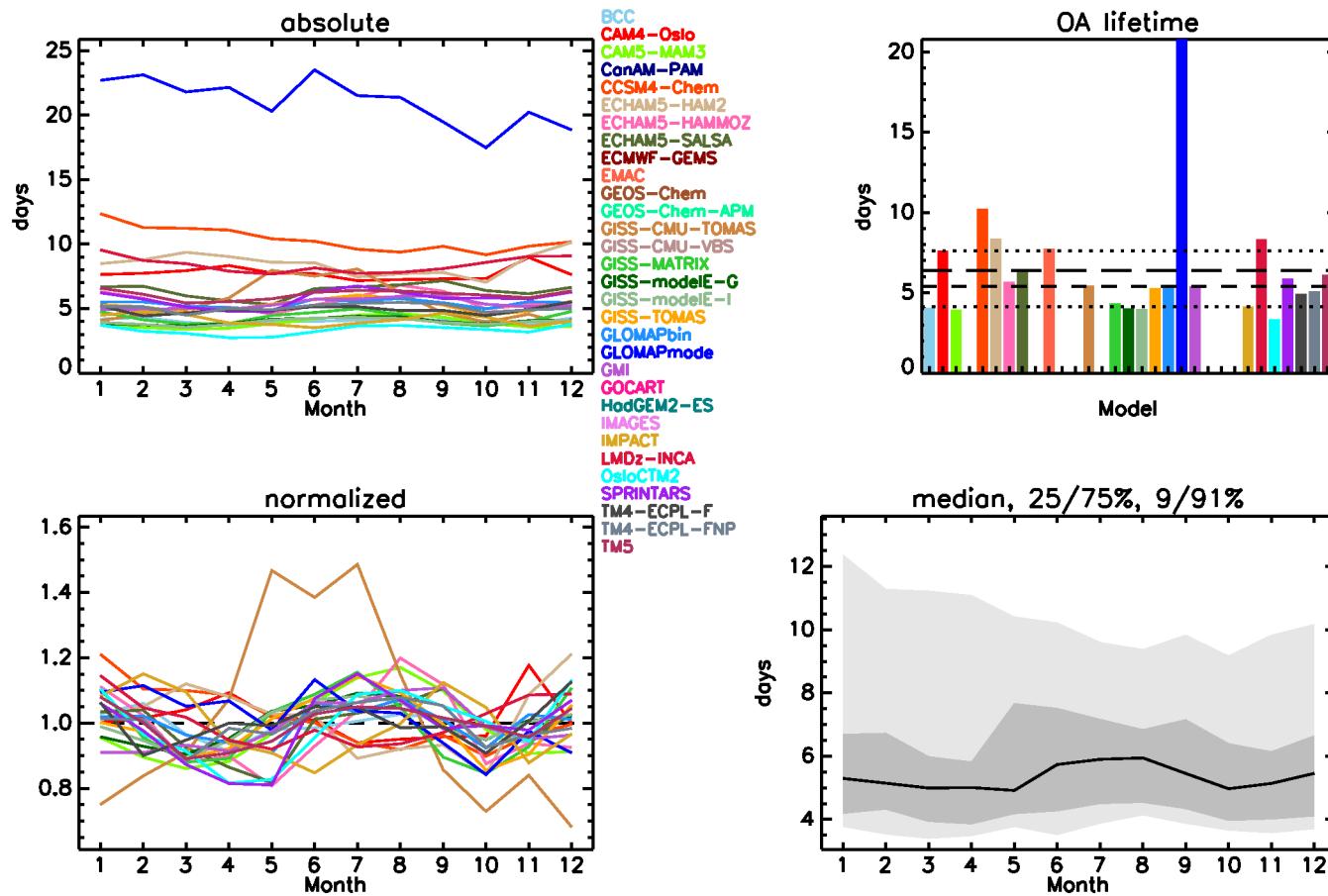


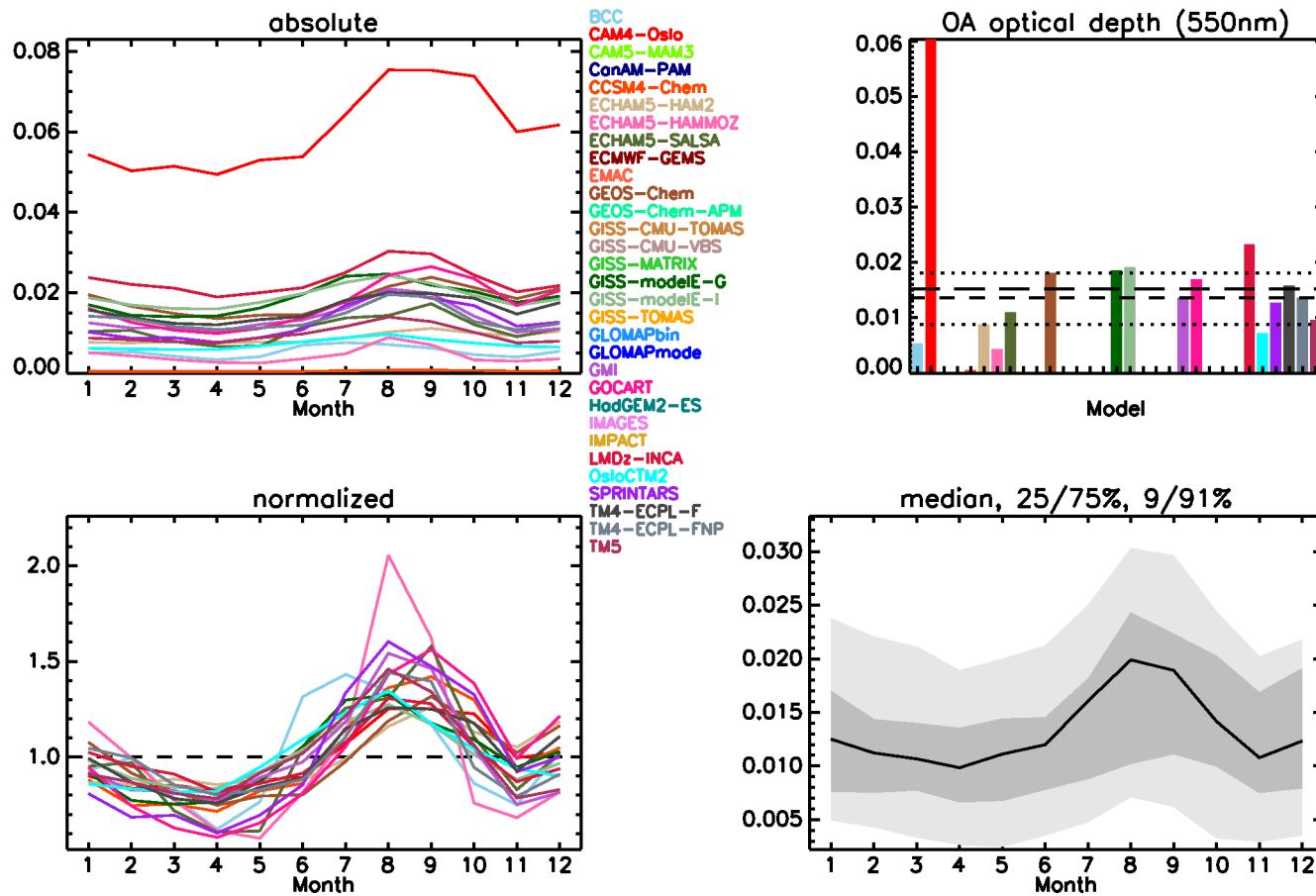




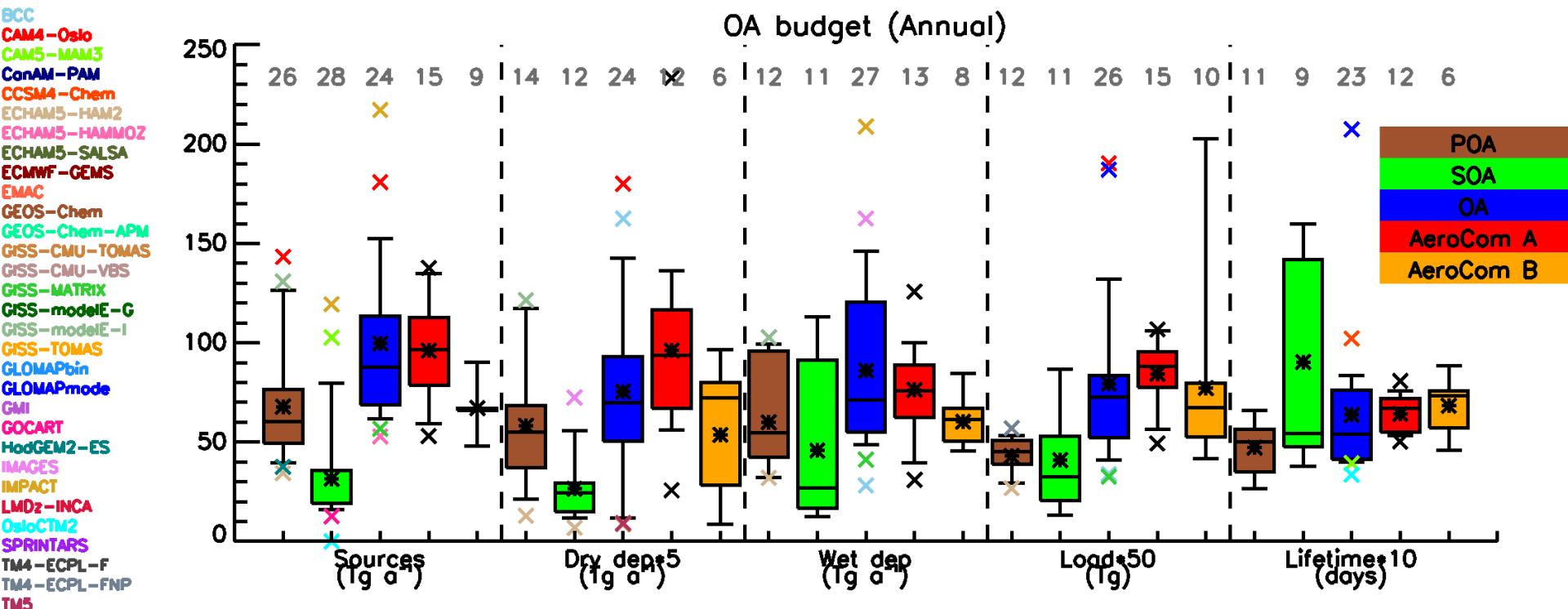






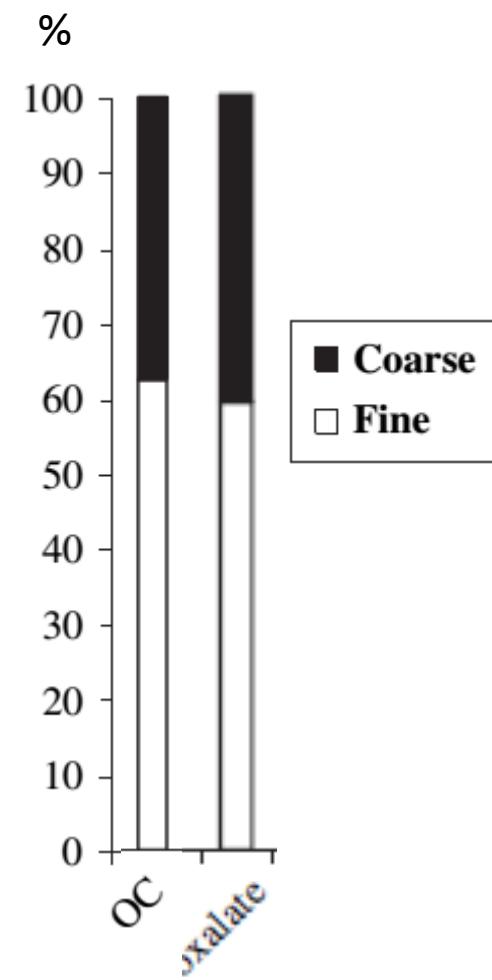
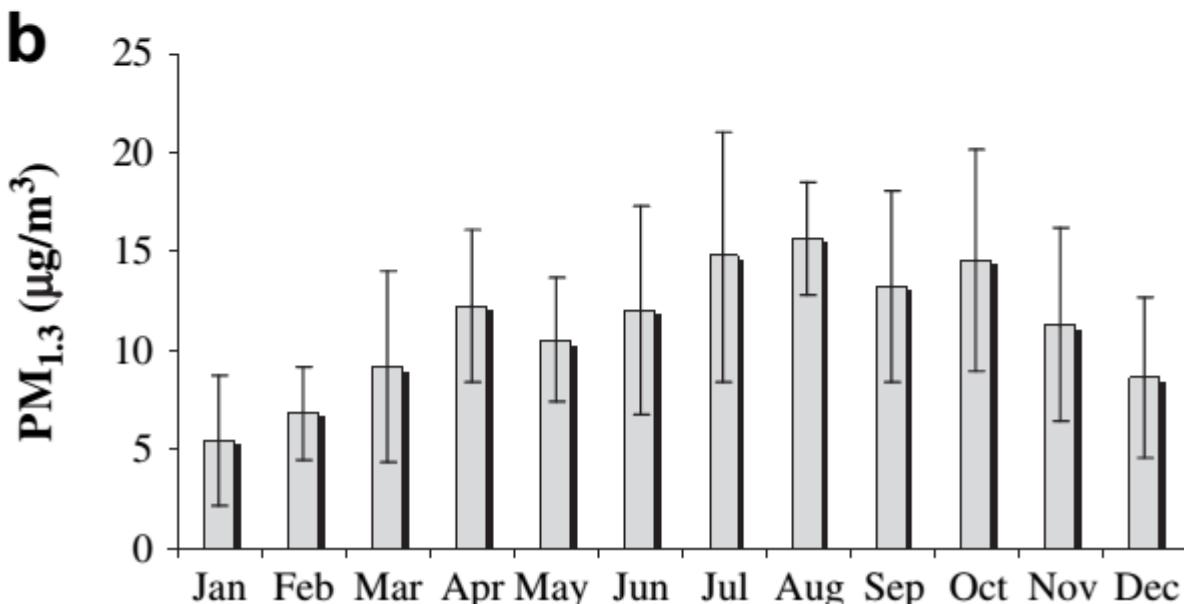
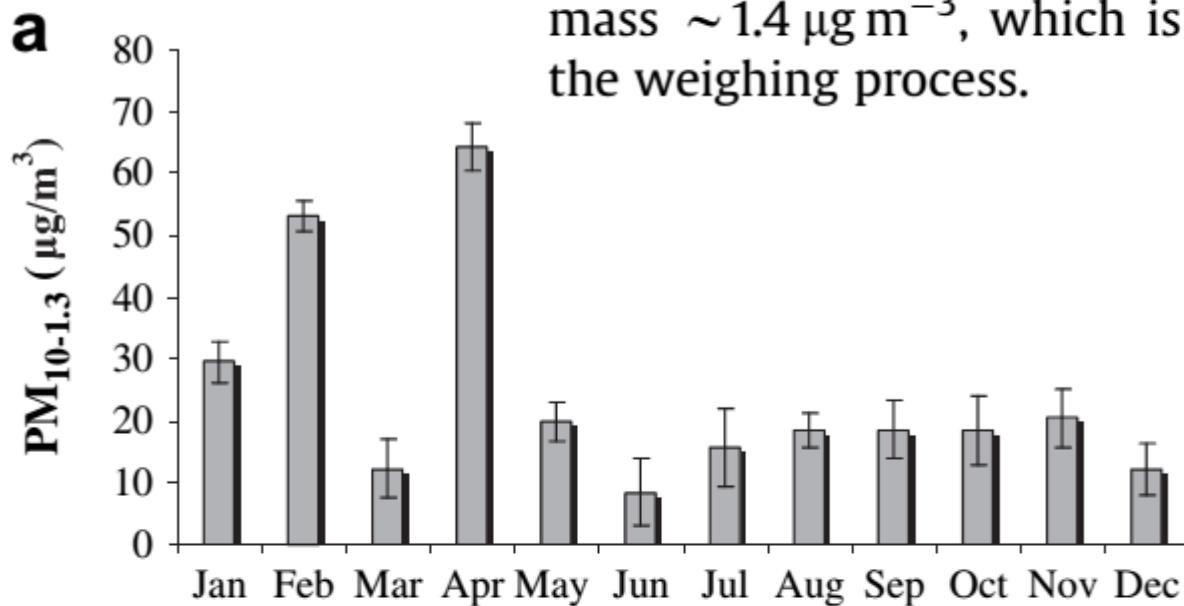


Budgets



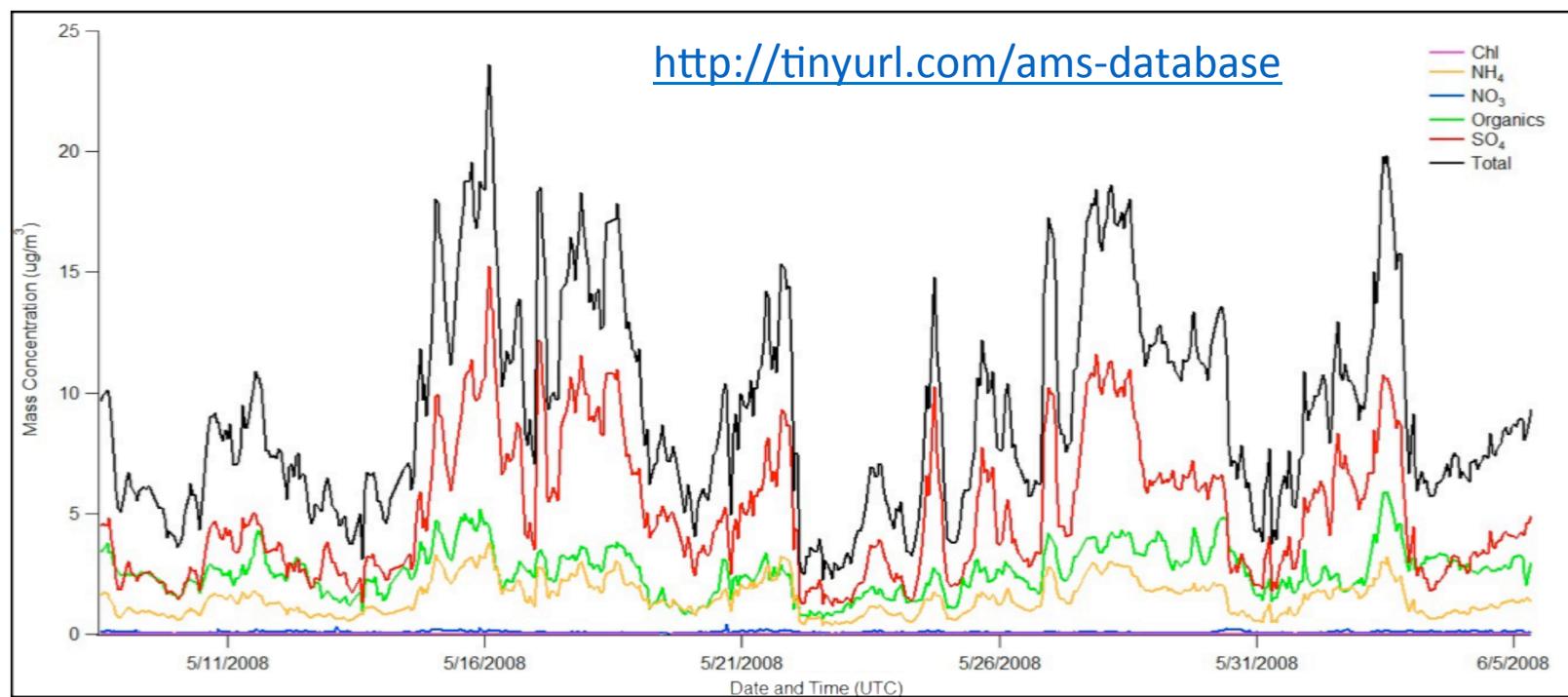
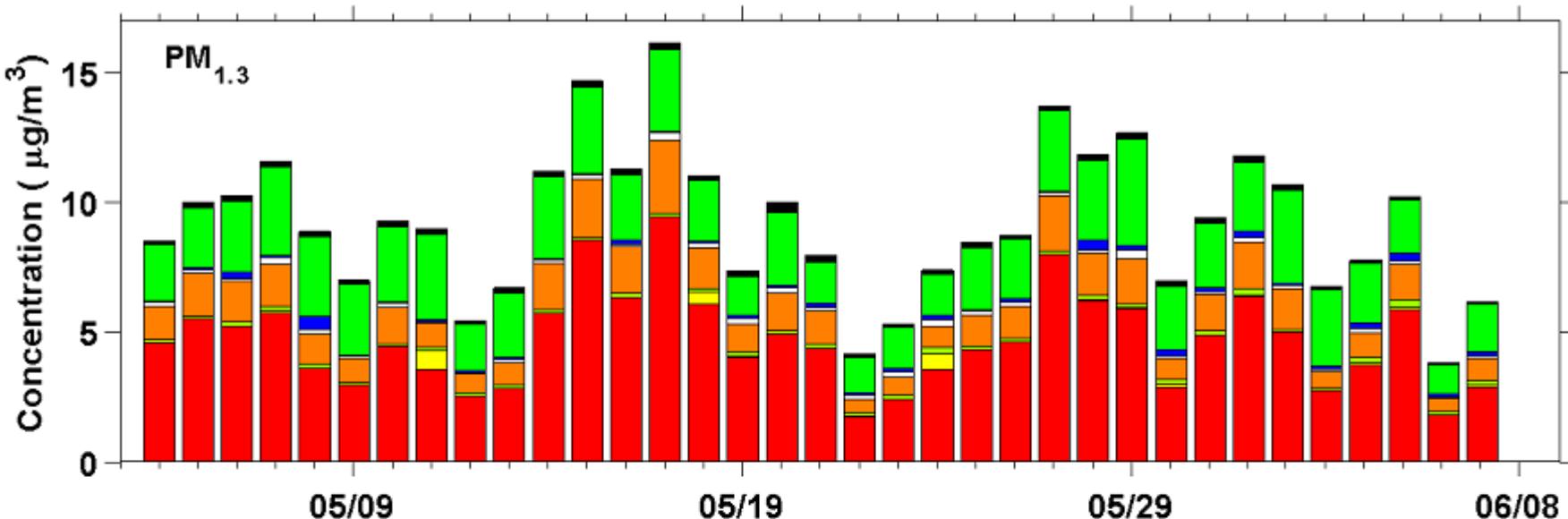
Measurements

$\text{PM}_{1.3}$ is on average 12% higher than PM_1 or by means of mass $\sim 1.4 \mu\text{g m}^{-3}$, which is 1.5 times the uncertainty of the weighing process.

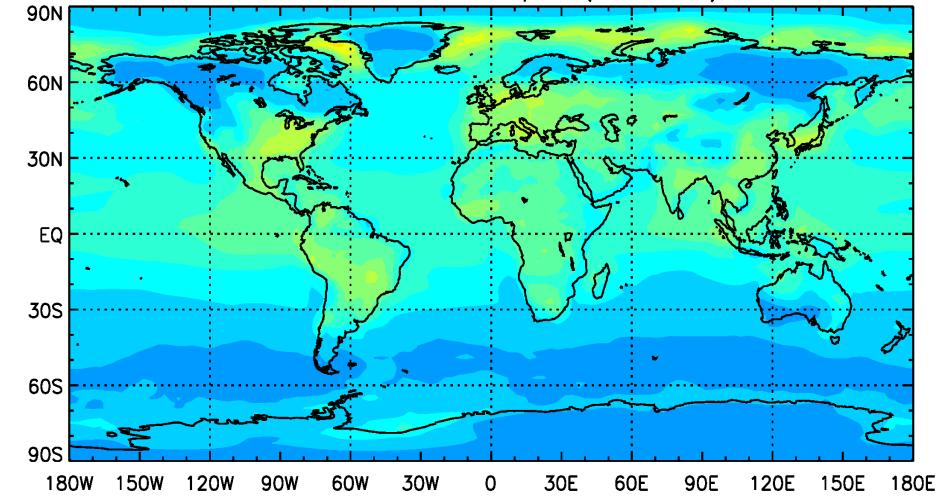
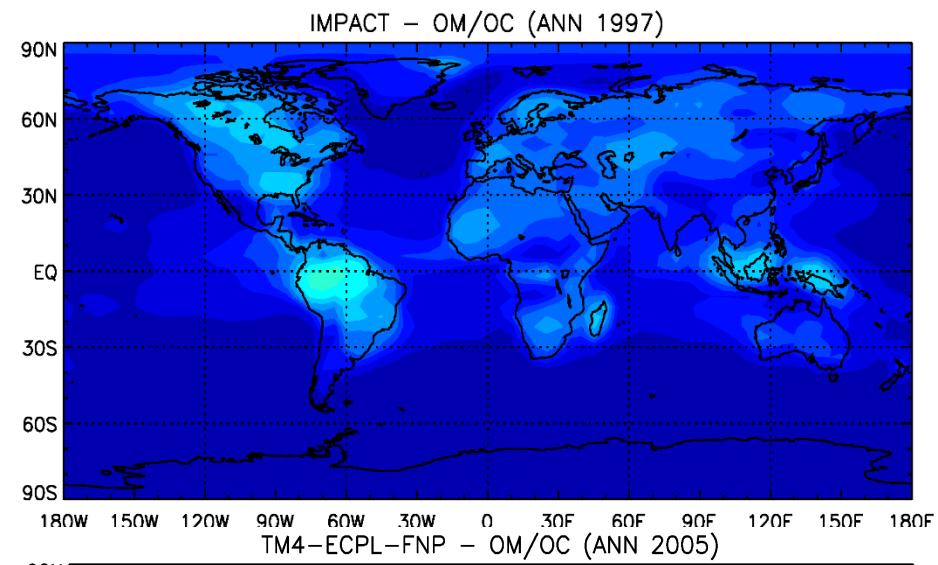
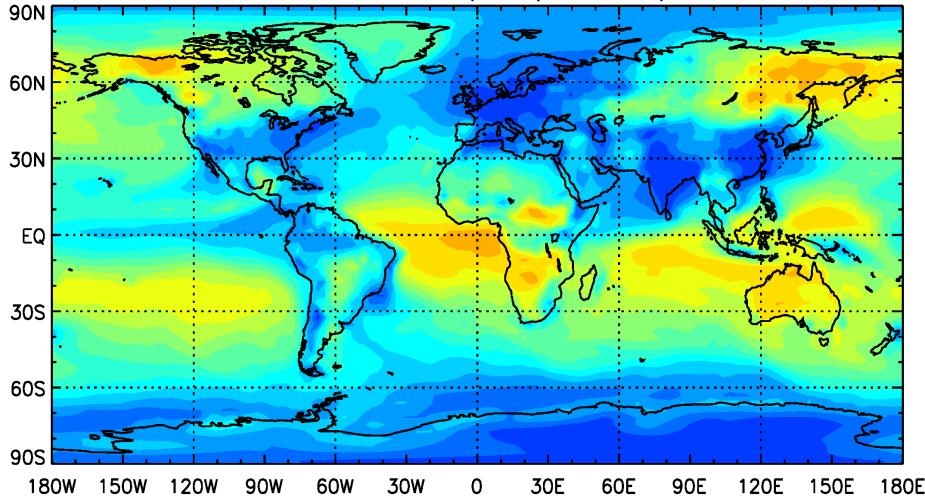
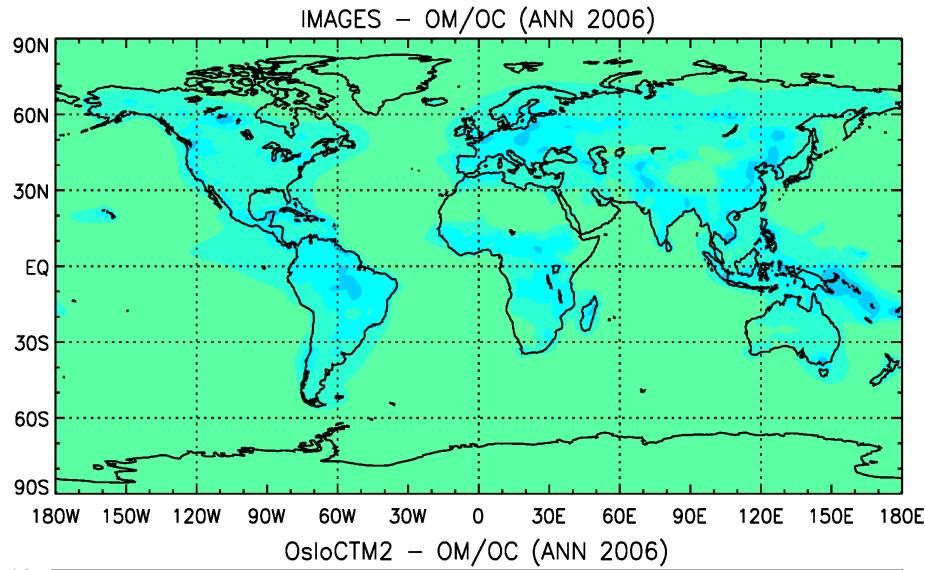


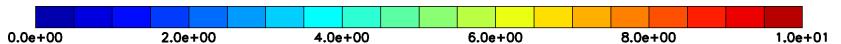
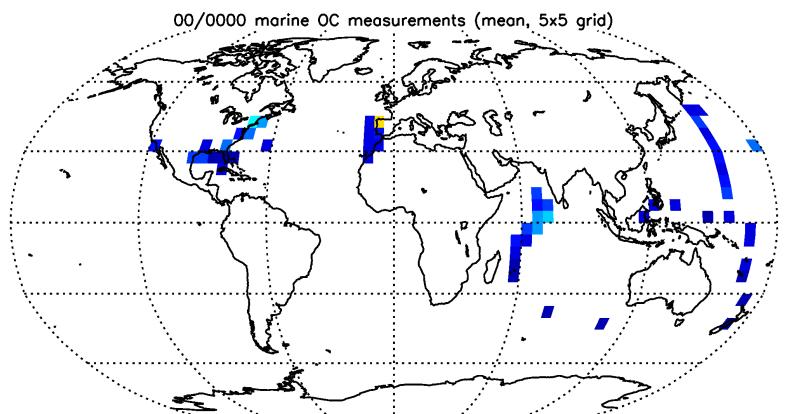
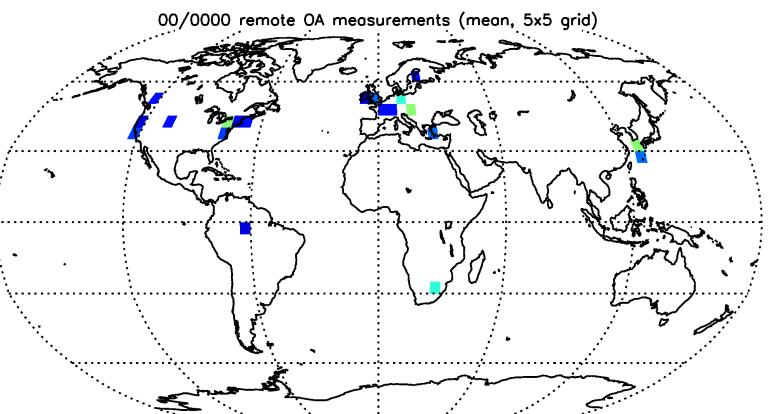
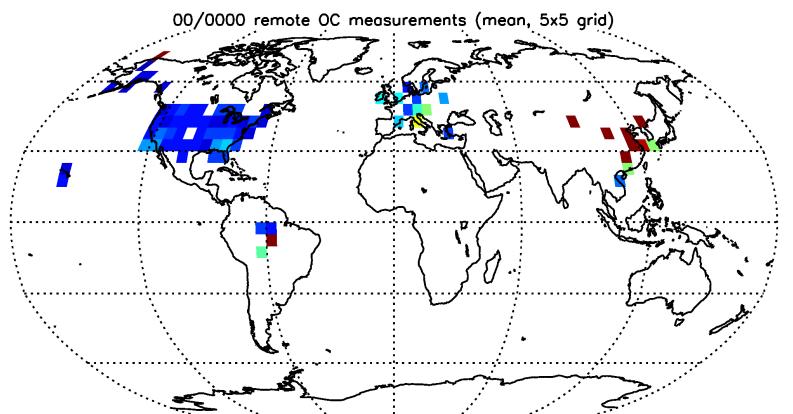
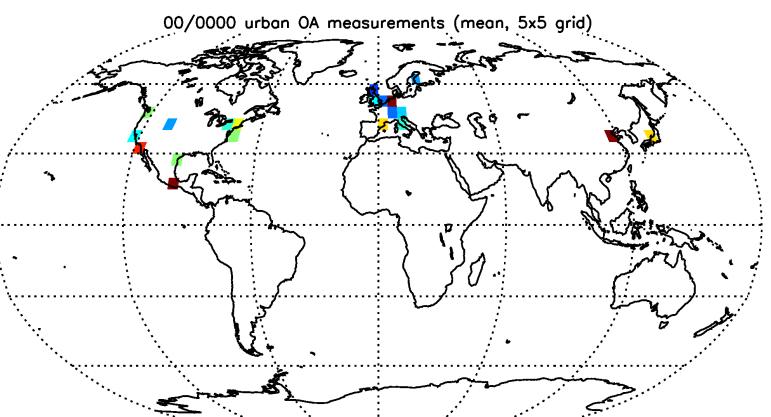
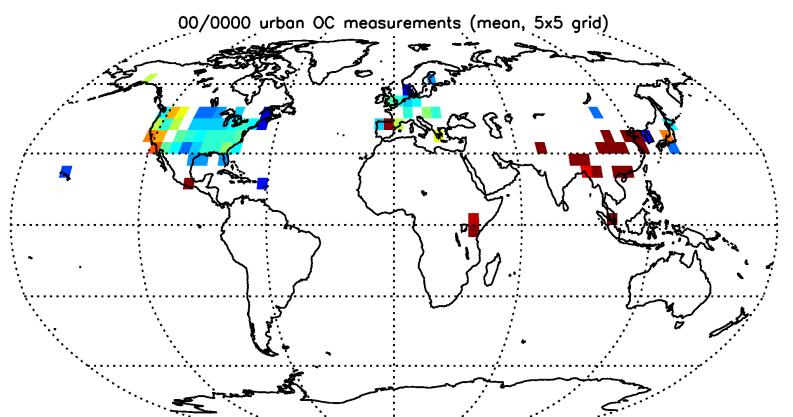
OM was calculated as OC \times 2.2

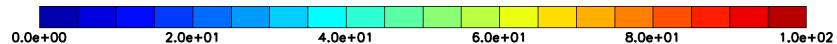
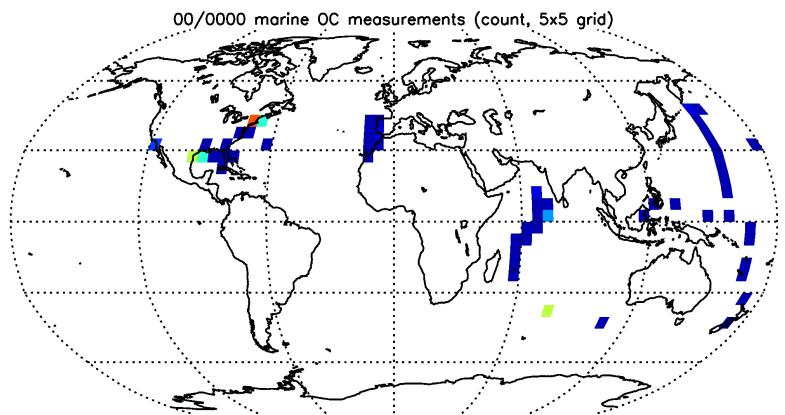
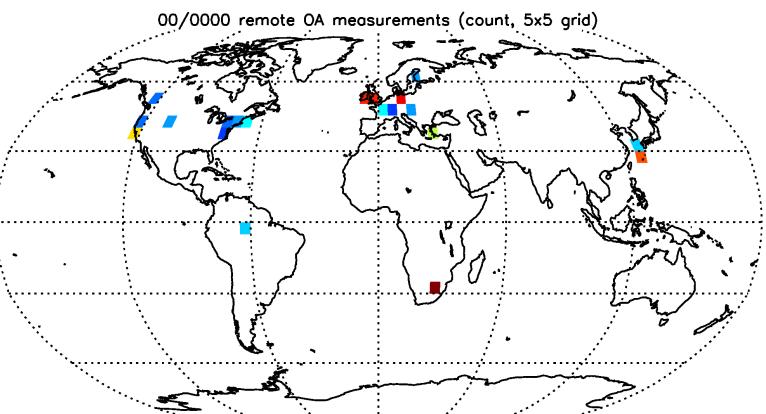
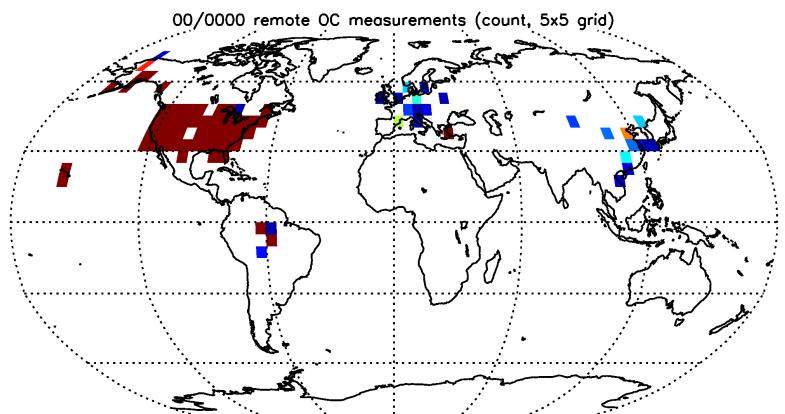
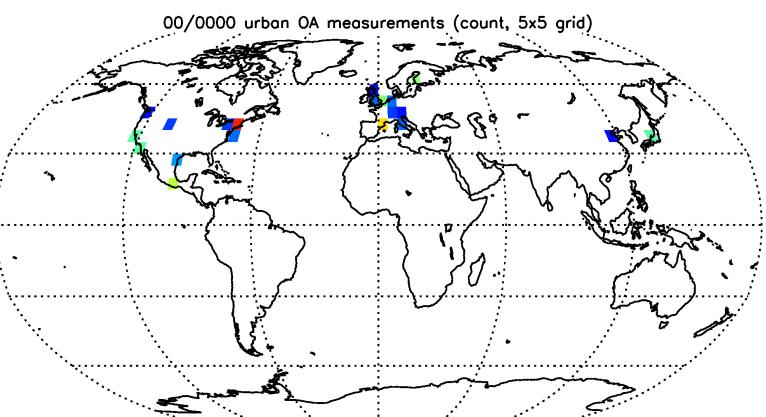
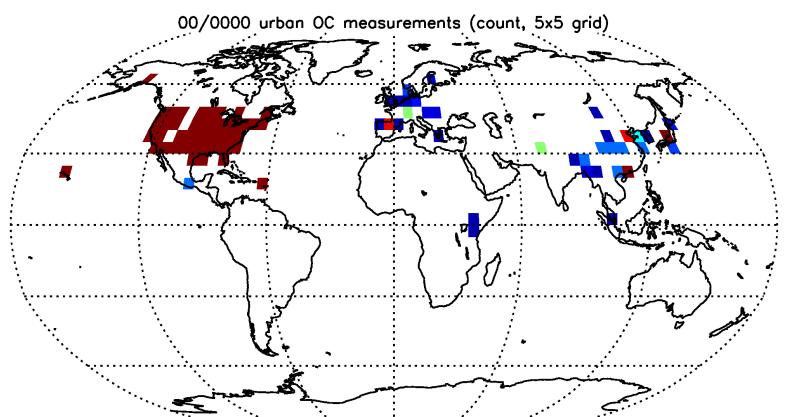
Finokalia, Greece (Pikridas et al., ACP, 2010)



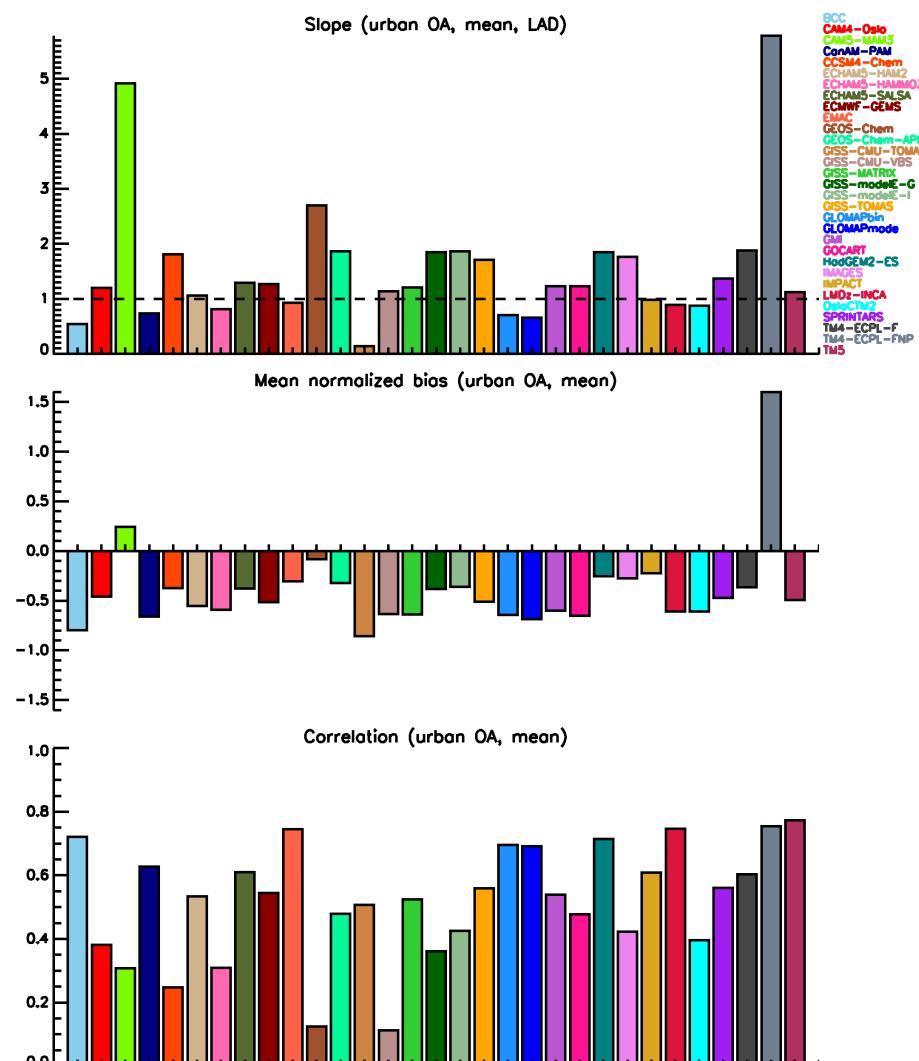
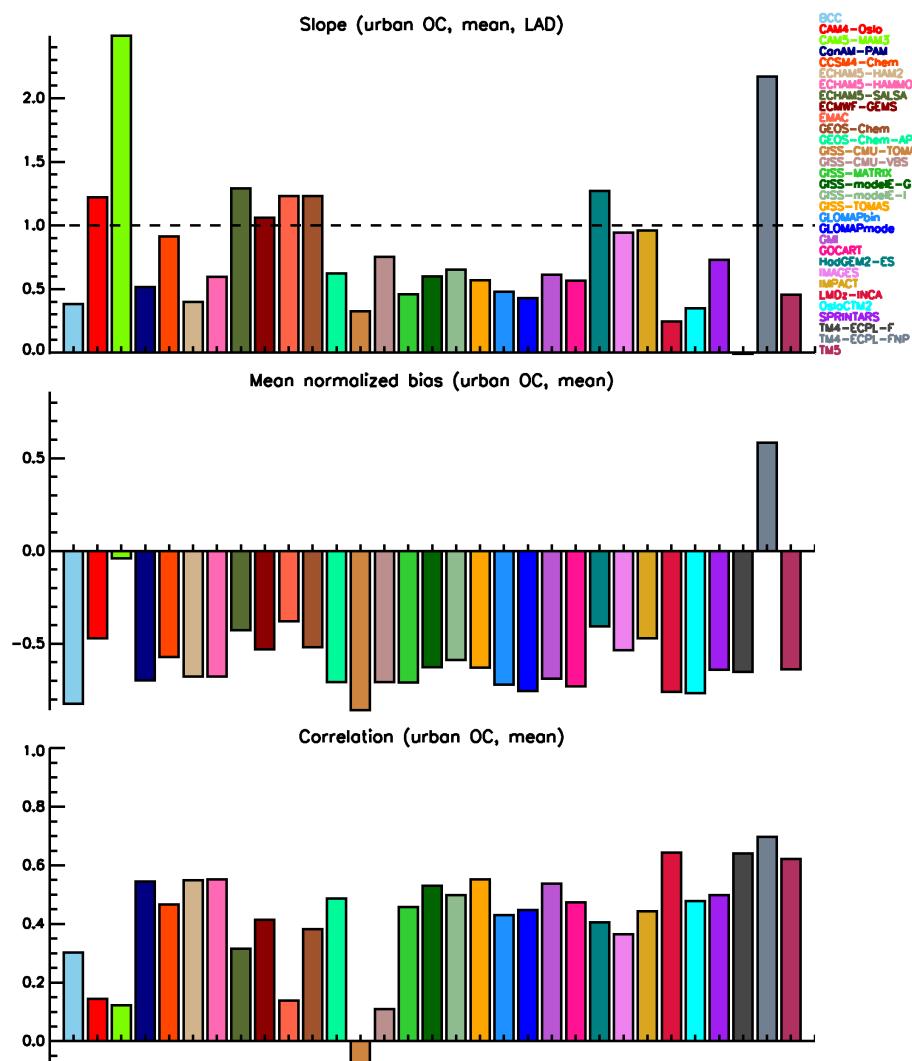
Most models have fixed OA/OC ratios, while few of them explicitly account for changes in OA/OC during oxidation and transport.



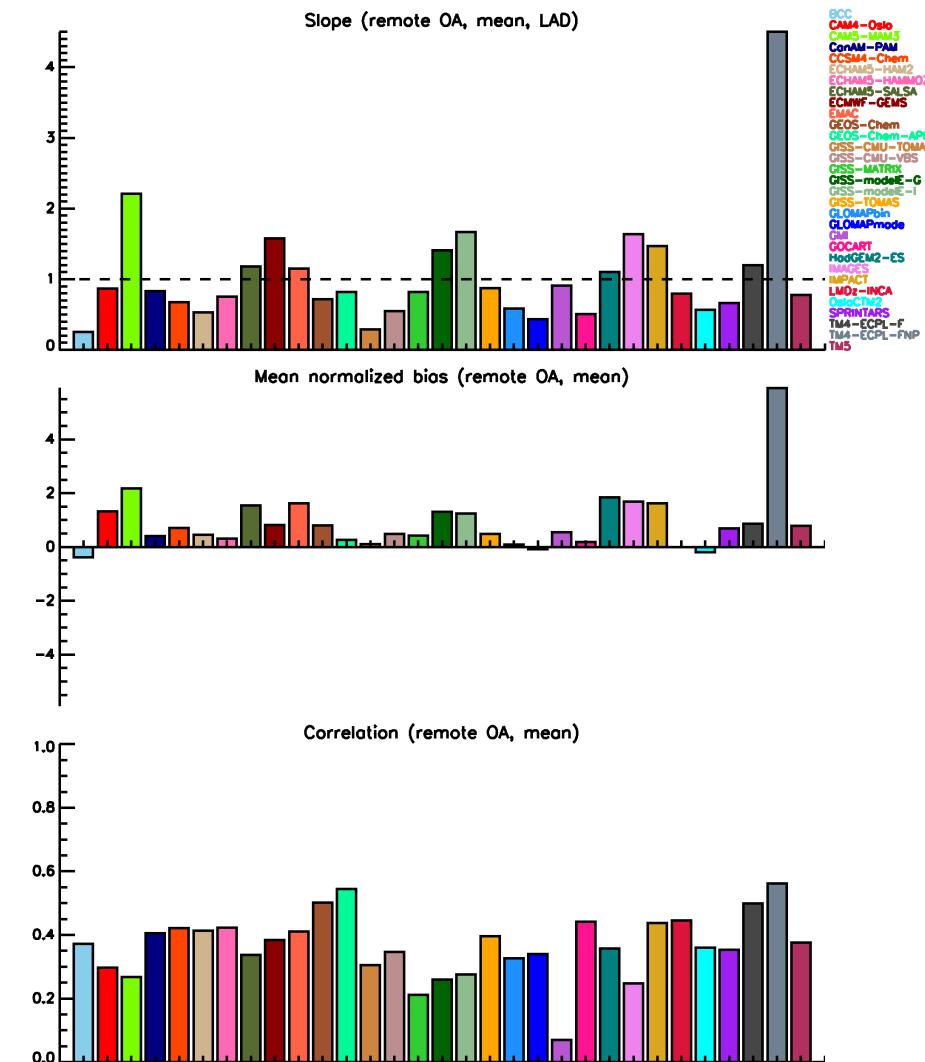
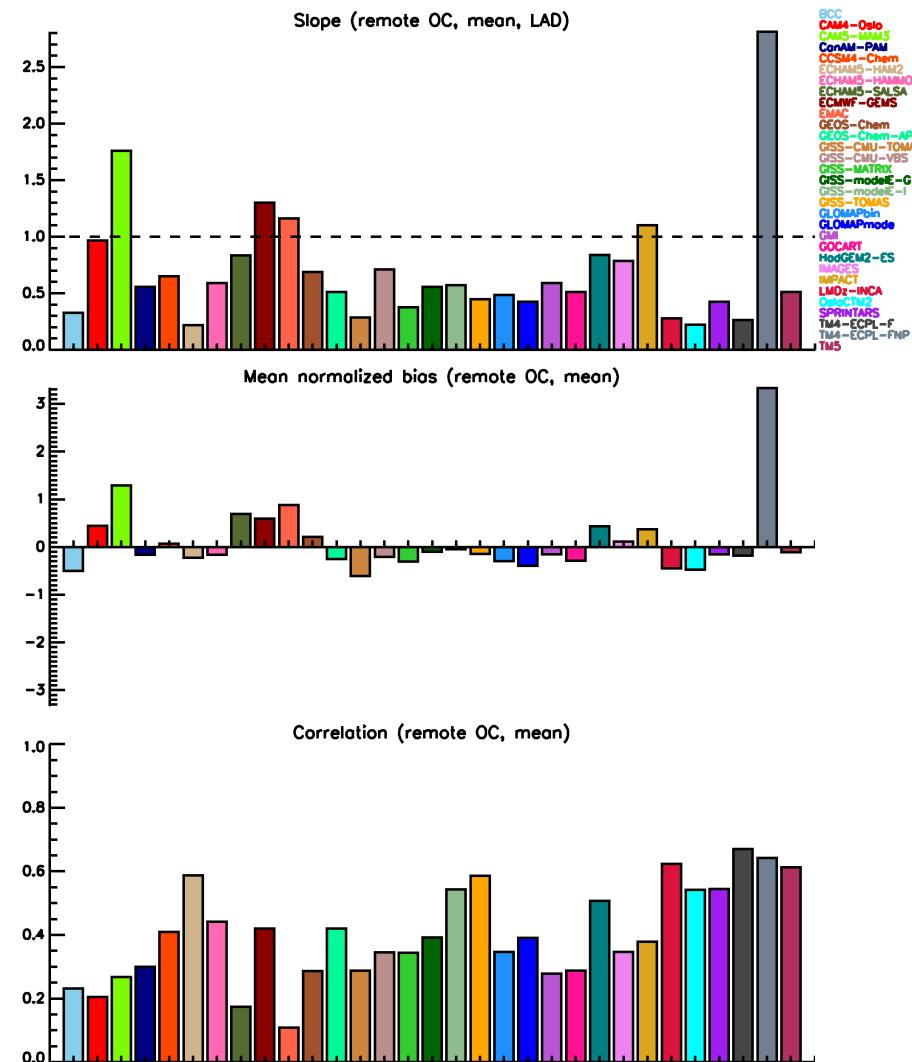




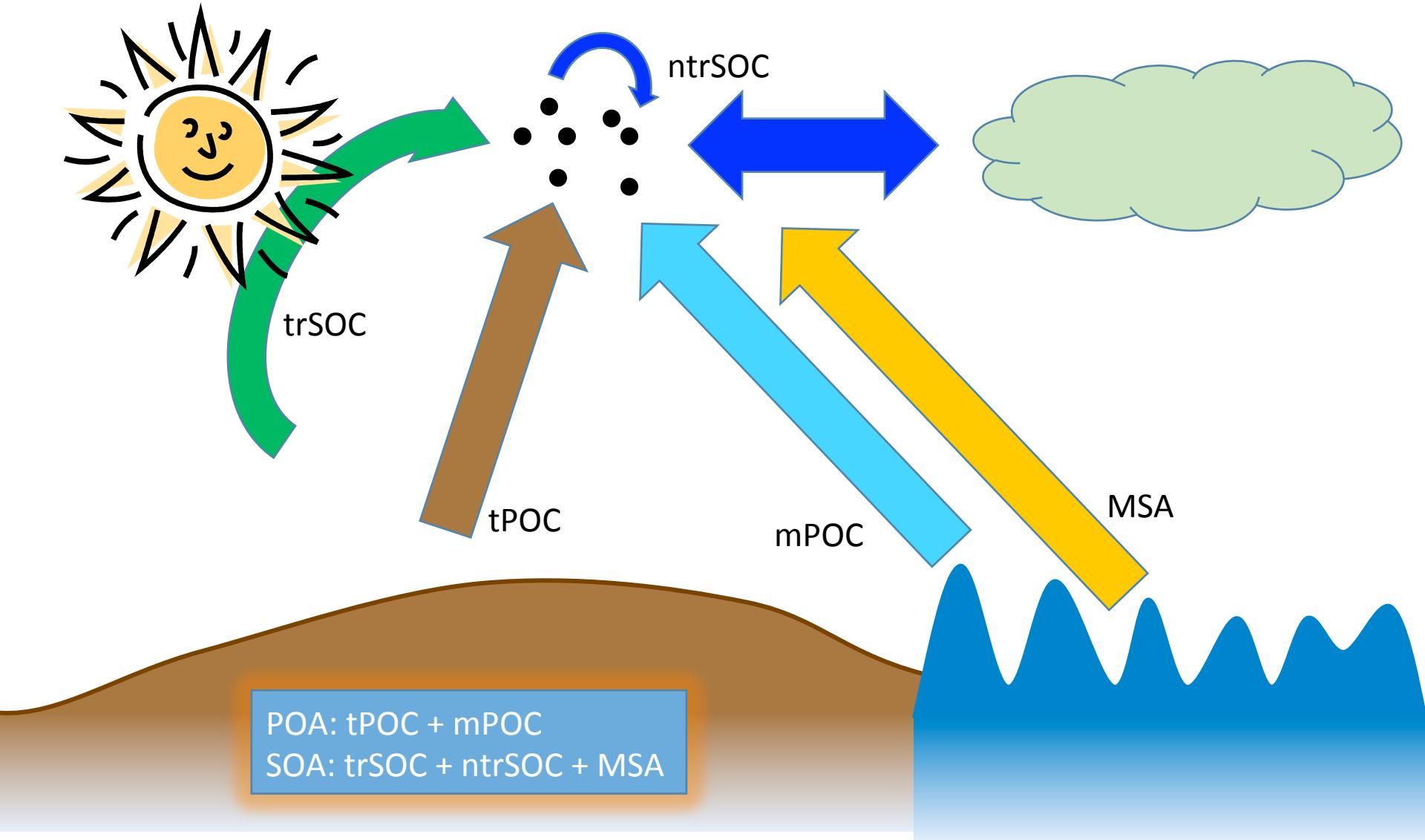
Statistics - urban

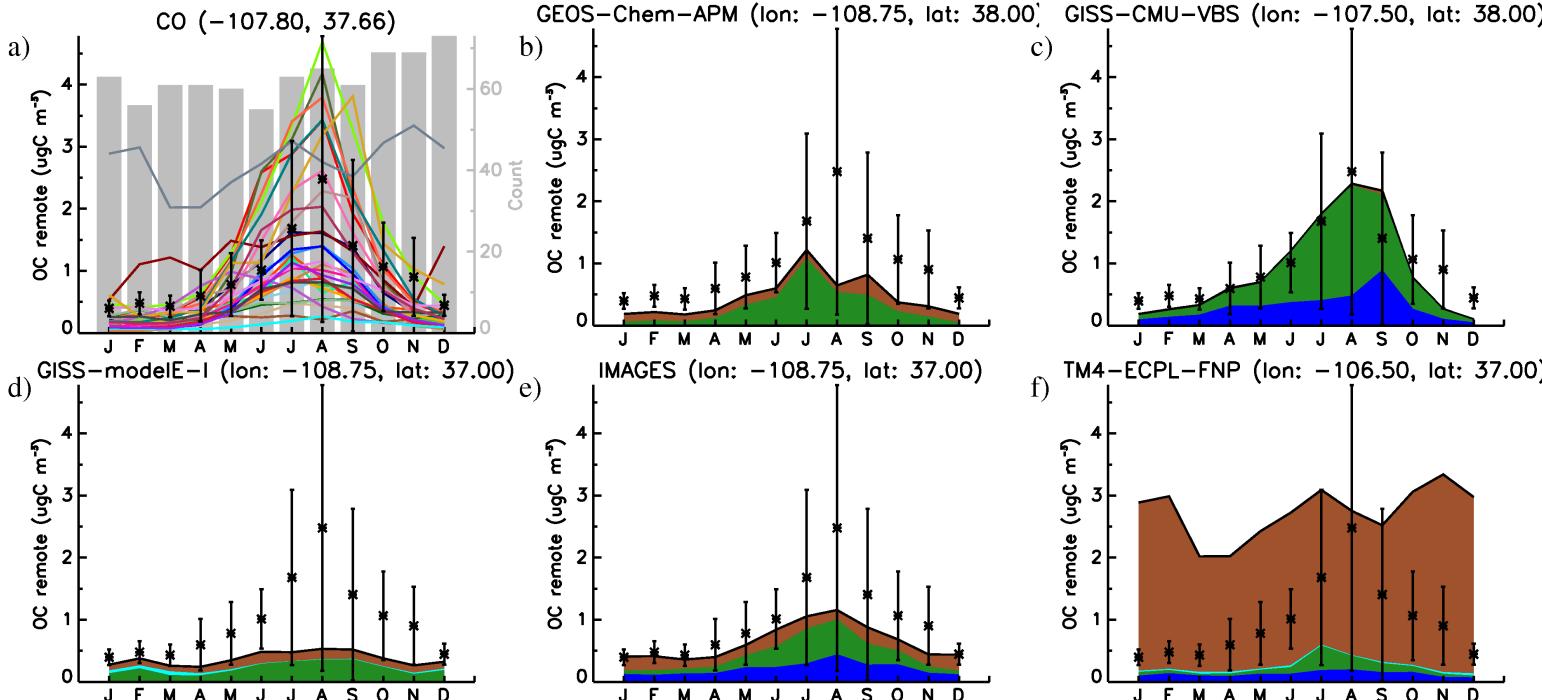
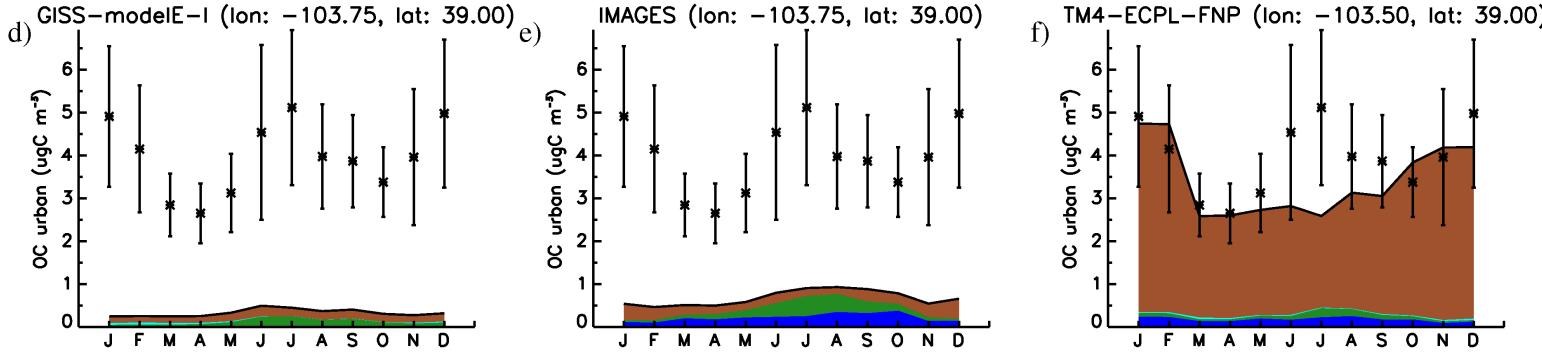
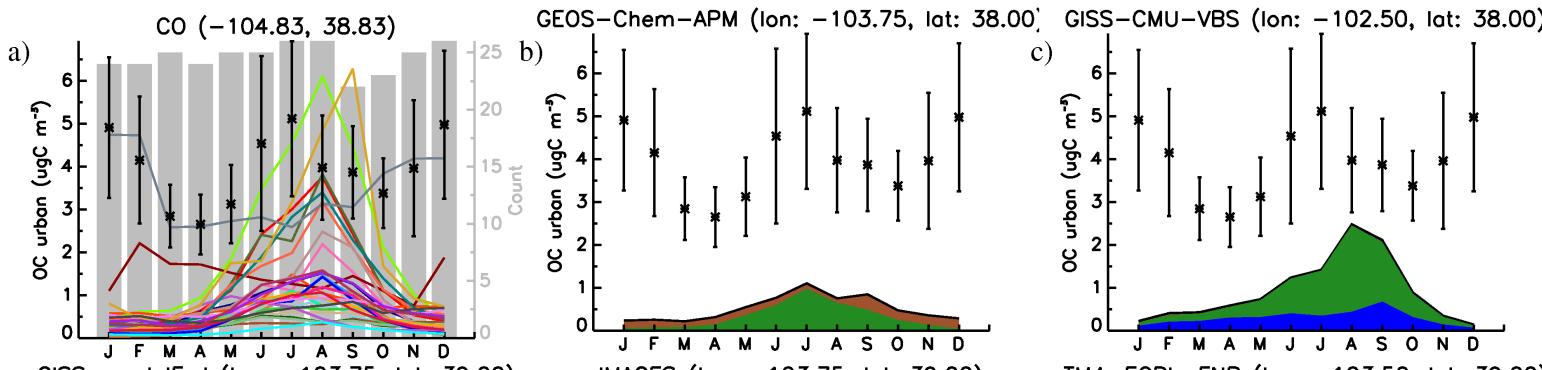


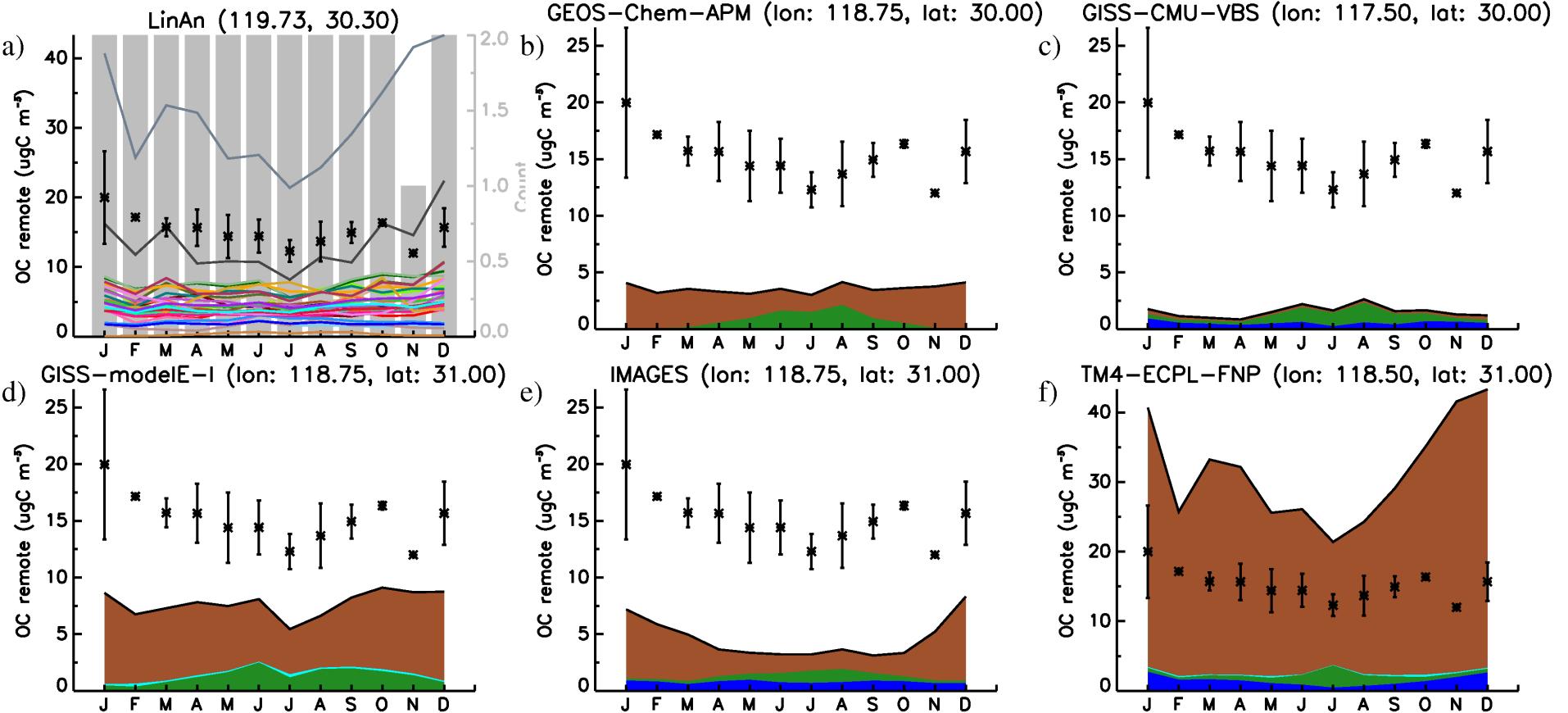
Statistics - remote

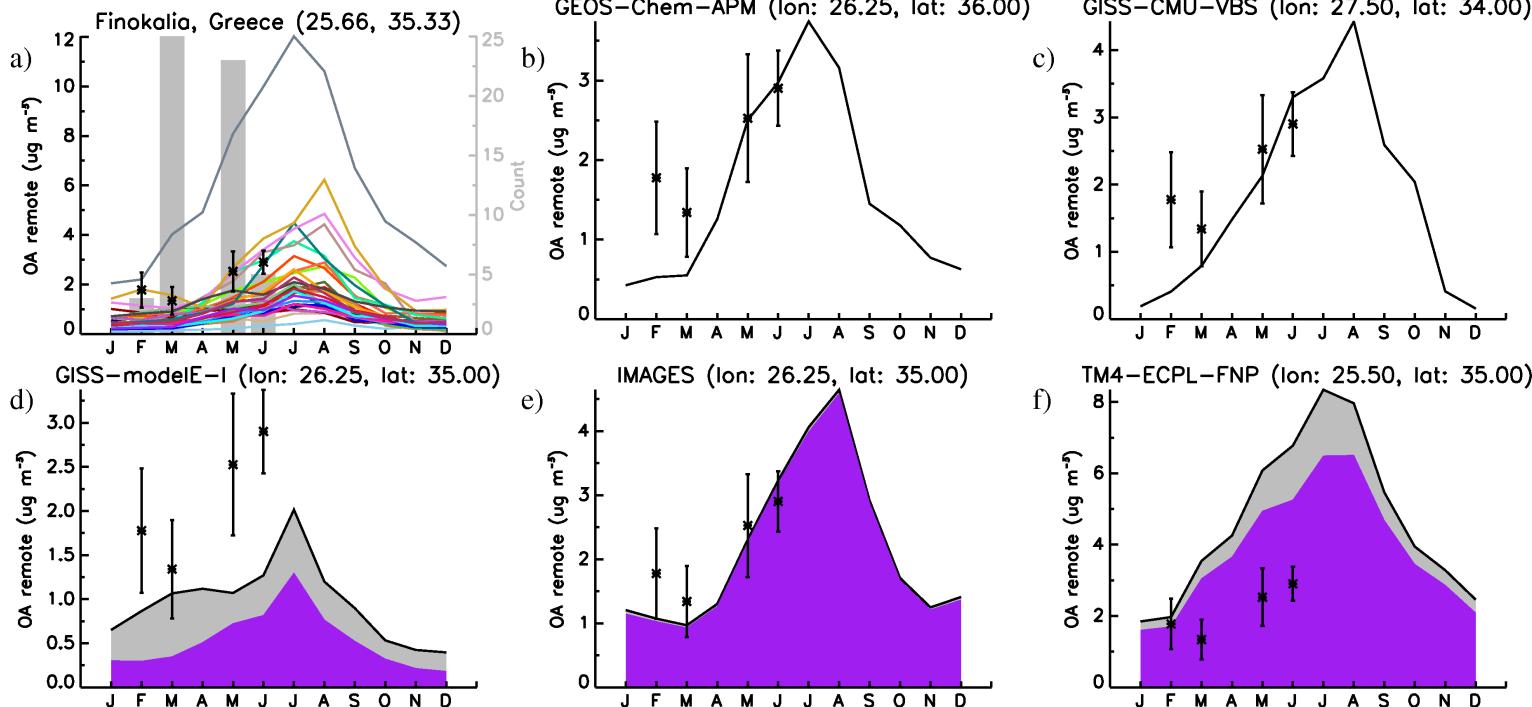
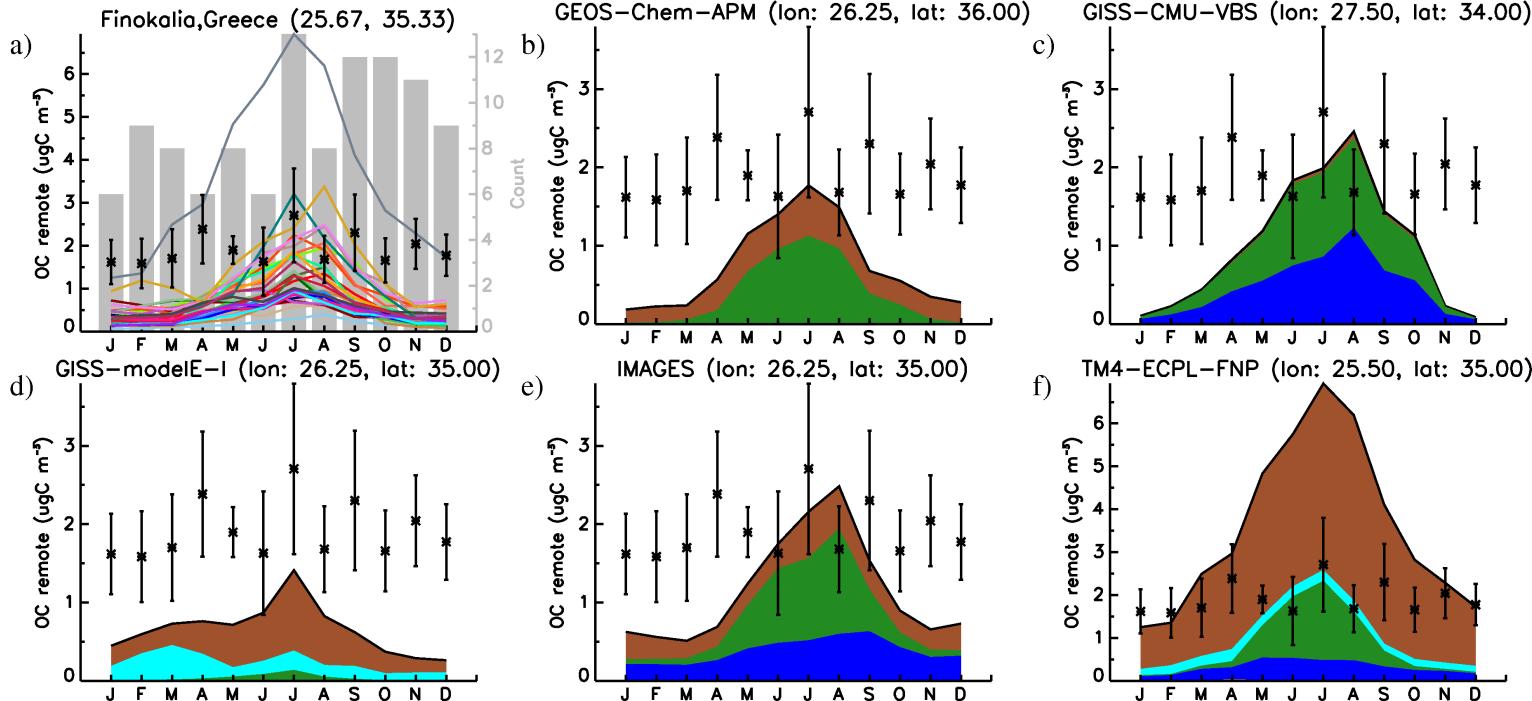


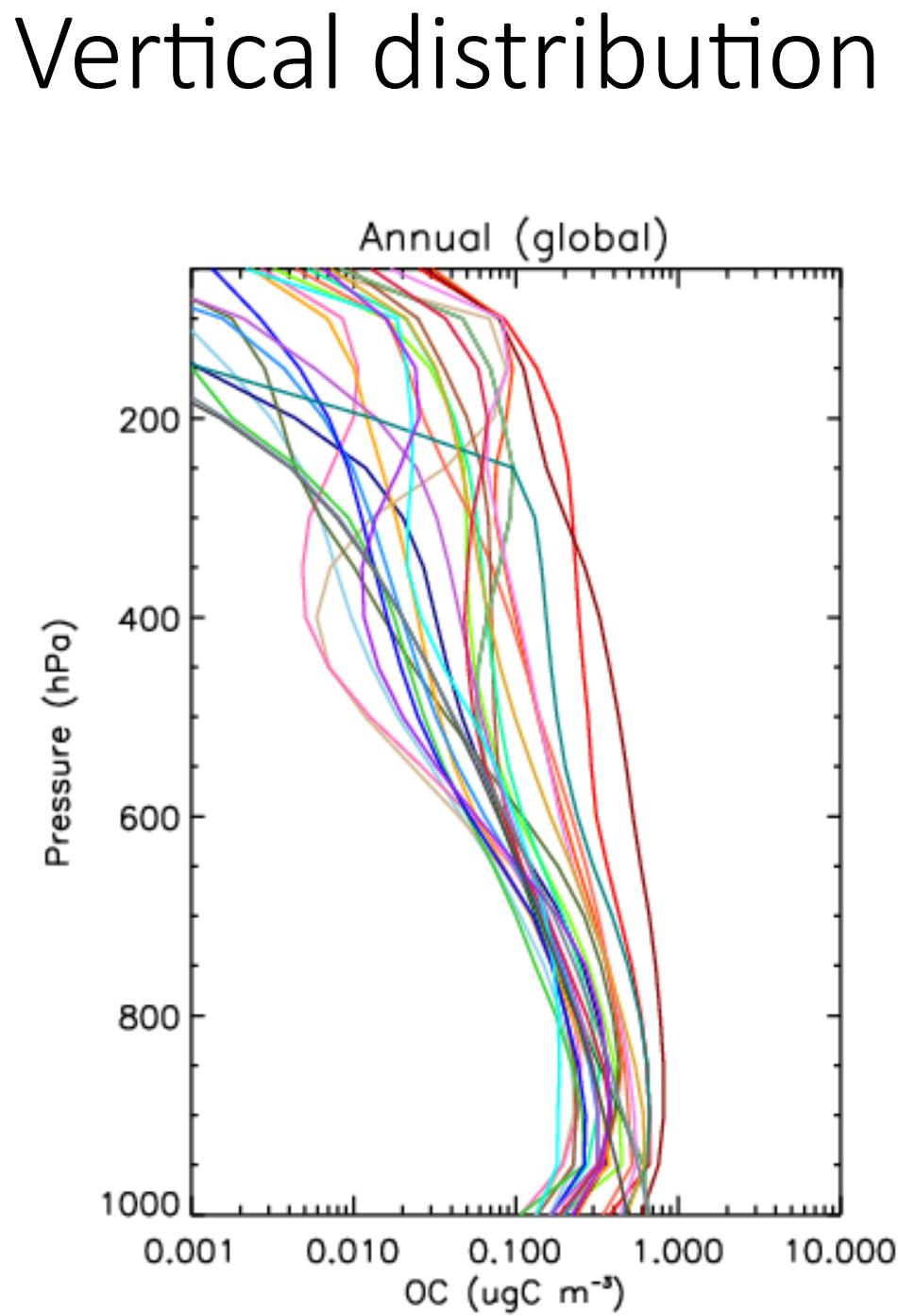
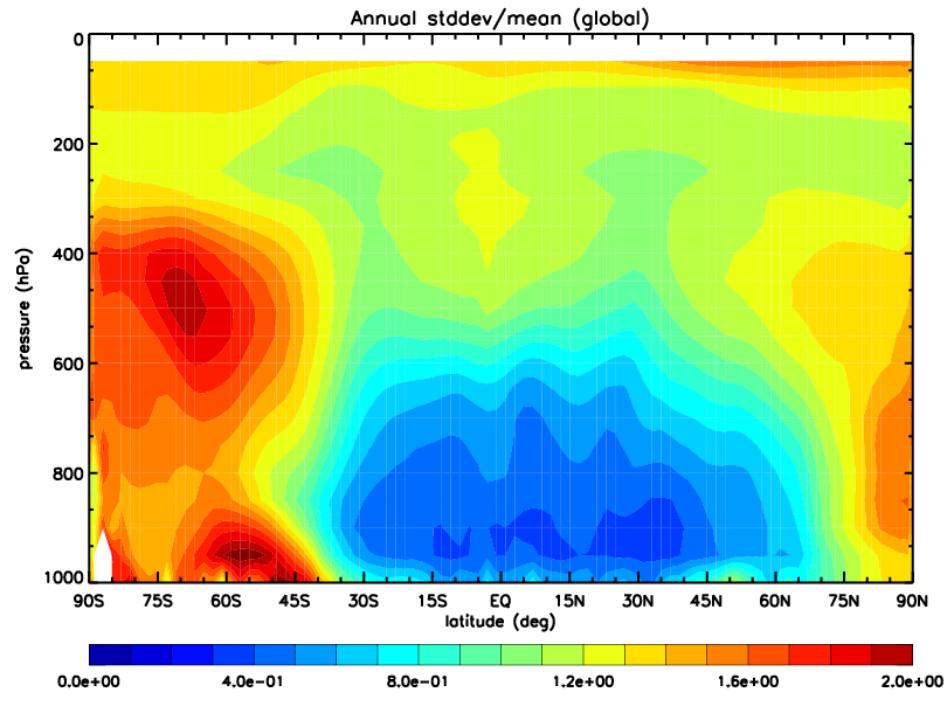
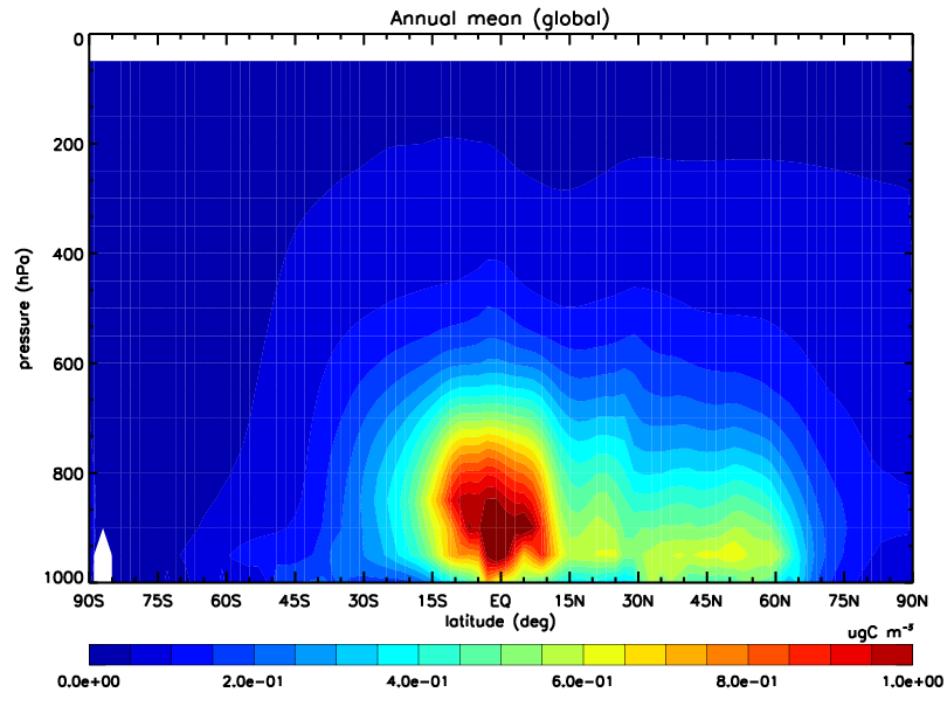
Source apportionment











Conclusions

- Diversity increased since AeroCom phase I.
- Missing OA source can be either anthropogenic or biogenic.
- OA/OC assumption affects model skill; OA appears to be better compared with measurements.
- More data are needed, spatial coverage still poor.
- OA/OC is our next study.
- Station-by-station comparison has a lot of information that waits to be exploited. The same is true for the vertical distribution.